DESIGN OF DUAL BAND ANTENNA

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ABSTRACT

In today's communication system antennas are the most important components for creating communication link. Microstrip antennas are used for mobile application and othercommunication application because of their light weight and low power handling capacity. The modern mobile communication system requires high gain, wide bandwidth and minimal size antennas that are capable of providing better performance over a wide range of frequency spectrum. This requirement leads to the design of microstrip patch antenna. This paper proposes the design of 2-Element microstrip patch antenna array which uses Quarter Wave Transformers (corporate feed) technique for excitation. Low dielectric constant substrates are generally preferred for maximum radiation. Thus it prefers FR4 as a dielectric substrate. Desired patch antenna design is initially simulated by using high frequency simulation software CAD-FEKO and patch antenna is designed as per requirement. Antenna dimensions such as Length (L),Width(W), and substrate dielectric constant and parameters like Return Loss, Gain and impedance are calculated using CAD-FEKO. The antenna has been design to the range 8-12GHz. Hence this antenna is highly suitable for X-band applications. For long distance communication we cannot use single element microstrip patch antenna. So for that purpose we are using microstrip patch array antenna. In this paper array stands for geometrical and electrical arrangements of patch elements. As number of patch elements goes on increasing, the performance is improved.A wide operating bandwidth for a single-layer corporate fed rectangular microstrip patch antenna can be obtained by cutting a U-shaped slot on the patch [12].

Keyword: *Microstrip patch array Antenna, Surface Current, Radiation Pattern, Efficiency, gain.*

1. INTRODUCTION

Microstrip antenna structures are most common option used to realize millimeter wave monolithic integrated circuit for microwave, radar and communication purpose. The microstrip antenna is also called as patch antenna and is fabricated by etching the antenna element. It contains metallic patch, dielectric substrate and ground plane. The dielectric substrate is sandwich between patch and ground plane. Low dielectric constant substrates are preferred for maximum radiation. So this patch is generally made up from various metals like silver, gold, zinc, etc. But here we are used copper metal because it is cheap and easily available in market. The patch metal may have different shapes Such as, rectangle, square, circle, triangle, circular ring. But Rectangular patch is commonly used because it is easy to use, fabricate and cheap. So we are using rectangular patch in this project. A microstrip antenna is characterized by its length, width, input impedance, and gain and radiation patterns. Numbers of single patch element are combining together to form an array. The array increases the gain and performance of antenna.The performance of microstrip antenna determines by using substrate material, dimension of antenna, feeding techniques. The four most popular feed techniques used are the insect feeding, coaxial probe (both contacting schemes), aperture coupling and proximity coupling (both non-contacting schemes). Microstrip antennas consist of metallic patch on grounded substrate. The patch is generally made of conducting material such as copper or gold and can take any possible

shape. The rectangular patch is most popular because of ease of analysis, fabrication and attractive radiation characteristics, especially low cross polarization radiation.

The microstrip are low profile, conformable to planar and nonplanar surfaces, simple and inexpensive to fabricate using modern printed-circuit technology and very versatile in terms of resonant frequency, polarization, pattern and impedance. This rectangular microstrip patch antenna is designed for wireless communication. These antennas can be mounted on surface of high performance aircraft, satellite, missiles, car and handheld mobile telephone.The concept of printed antennas was originally proposed by Deschamps in 1953. However, it to ok more than twenty years until Munson realized the microstrip antenna. In 1979 an antenna symposium held in New Mexico initiated an international interest in microstrip antennas.

2. DIAGRAM

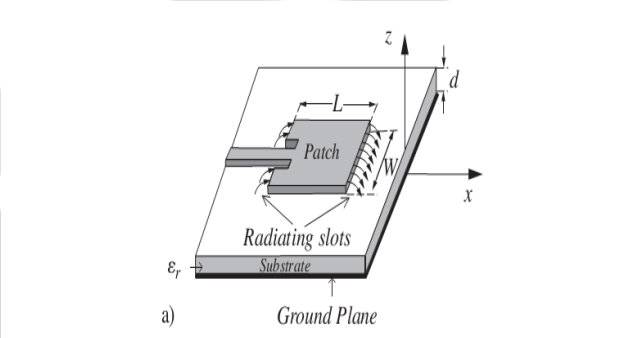

Fig-1: Structure of microstrip patch antenna

For a rectangular patch, the length L of the element is usually $\lambda_0/3 < L < \lambda_0/2$, where $\lambda_0$is the free space wavelength. The patch is selected to be very thin such that $t << \lambda_0$(where t is the patch thickness). The height h of the dielectric substrate is usually $0.003\ \lambda_0 \leq h \leq 0.05\ \lambda_0$. There are numerous substrates that can be use for design of microstrip antennas, and their dielectric constants are usually in the range of $2.2 \leq \varepsilon_r \leq 12$.

3. DESIGN

Design the slot. The U-slot is composed of two paralleled vertical rectangular slots and a horizontal rectangular slot. U-slot plays an important role to control the wideband behaviour of the coupled patch antenna. There are three parameters to characterize the slots, namely slot length, slot position, and slot width. During the process of the optimization, we can exhibit a wider bandwidth.

3.1 Theoretical design-1

Step 1: Calculation of the Width (*W*):

The width of the Microstrip patch antenna is given as:

Where;

c - Free space velocity of light, 3×10^8 m/s

fr - Frequency of operation

ε_r - Dielectric constant

Step 2: Calculation of Effective dielectric constant (ε_{reff}):

The effective dielectric constant is:

Where;

ε_r - Dielectric constant

h - Height of dielectric substrate

W - Width of the patch

Step 3: Calculation of the Effective length (L_{eff}):

The effective length is:

Where;

c - Free space velocity of light, 3 x 10^8 m/s

f_r - Frequency of operation

ε_{reff} - Effective dielectric constant

Step 4: Calculation of actual length of patch (L):

The actual length is obtained by:

$$L = L_{eff} - 2\Delta L$$

Where,

L-Actual length of patch.

L_{eff} -Effective length.

ΔL-Small difference between length.

3. CALCULATION

Table -1: Dimensions

Patch Shape	Rectangular
Frequency	8GHz-12GHz
Dielectric constant of substrate	4.4
Height of substrate	1.6mm
Feeding method	Corporate Feed
Polarization	Linear

4. SIMULATION RESULTS

The simulated results of antenna are measured using CAD-FEKO version 7.0. As we know for proper transmission of signal by antenna, the S11 parameter of antenna should be less than -10d

4.1 S-parameter-1

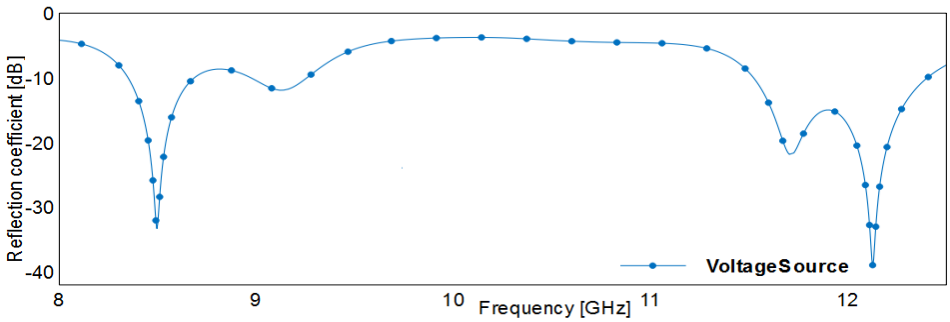

Fig.2: S-parameter

4.2 Gain-2

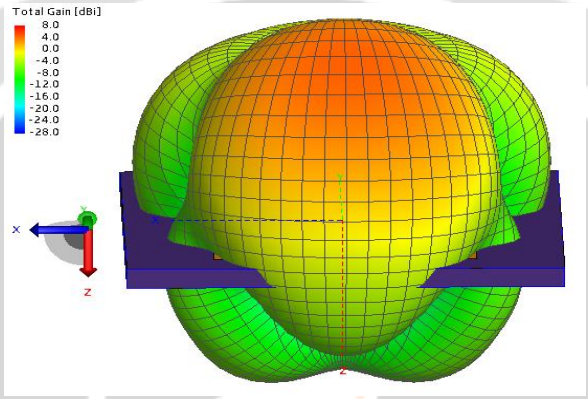

Fig.3: Gain

4.3 Efficiency-3

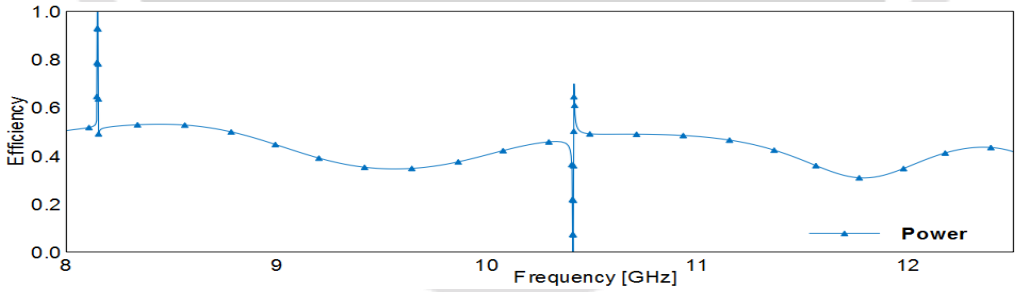

Fig.4: Efficiency

4.4 Radiation pattern-4

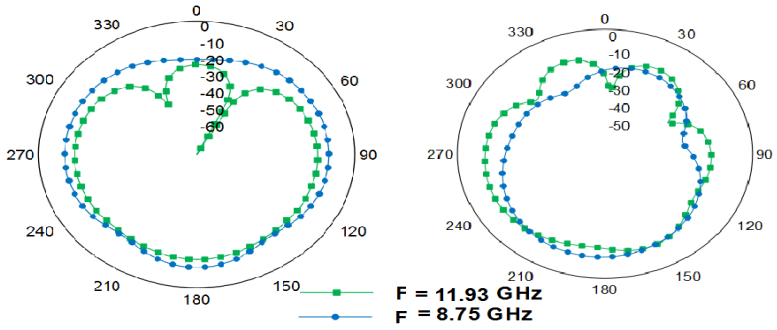

Fig.5: Radiation Pattern

4.5 Surface Current-5

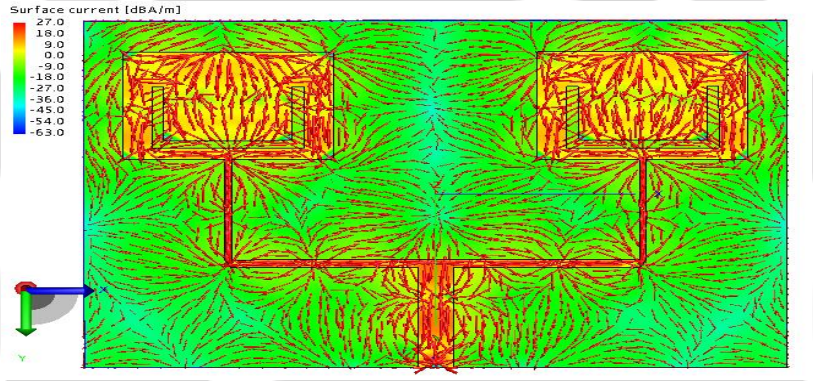

Fig.6: Surface Current

5. COMPARATIVE STUDY OF SIMULATION RESULTS

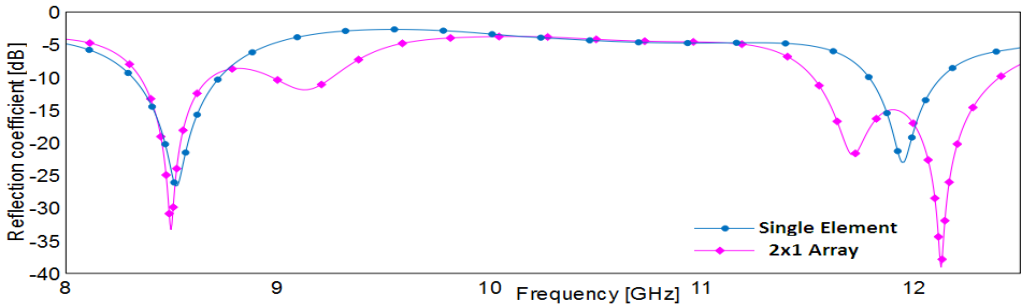

Fig.7: Comparison between single element and array

6. APPLICATION

The microstrip patch array antenna used for GPS as well as RADAR. It is also useful in RFID, Wi-Max applications. In satellite and aircraft communication it is widely used. It also used in the WLAN as well as Bluetooth communication. And also in 3G communication system and for mobile communication this antenna is widely used.

7. CONCLUSION

The aim of this paper is to study the reviews on a rectangular patch microstrip antenna .In this project an antenna has been designed with different design parameters at operating frequency 8-12 GHz. A wide operating bandwidth for a single-layer corporate fed rectangular microstrip patch antenna can be obtained by cutting a U-shaped slot on the patch.Taking all this into consideration we can say that there are many aspects that affect the performance of the antenna. Dimensions, selection of the substrate, feed technique and also the operating frequency can take their position in effecting the performance. We can vary bandwidth and gain of microsrtip antenna by varying different antenna parameter and by changing the size of antenna.

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BIOGRAPHIES

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