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DESIGN AND ANALYSIS OF TRIANGULAR SLOT MICROSTRIP PATCH ANTENNA FOR C BAND APPLICATION

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Abstract:- A receiving wire is a gadget that transmits the sign starting with one end then onto the next delivering EM field comprising of electric field and attractive field. Microstrip fix reception apparatuses are become scientist decision in light of the fact that these receiving wire have different preferred position like low weight, cost, size, profile and its manufacture. This undertaking presents the triangular space rectangular fix reception apparatus for improving the addition and it is worked for C-band applications. The cutting edge versatile correspondence frameworks requires high increase, enormous transmission capacity and insignificant size radio wire's that are equipped for giving better execution over a wide scope of recurrence range. This prerequisite prompts the plan of Microstrip fix receiving wire. To structure a microstrip line took care of triangular opening rectangular microstrip fix receiving wire which works in C-band at wanted recurrence extend. The reception apparatus can be structured by utilizing cst programming.

Key Words: EM field, C-band, Microstrip patch, Frequency spectrum.

1. INTRODUCTION

Correspondence between people was first by sound through voice. With the craving for marginally more separation specialized gadgets, for example, drums, visual technique, for example, signal banners and smoke signals were utilized. These optical specialized gadgets, obviously, used the light bit of the electromagnetic range. It has been without a doubt, later in mankind's history that the electromagnetic range, outside the obvious area, has been utilized for correspondence, using radio. One of mankind's most noteworthy common assets is the electromagnetic range and the receiving wire has been instrumental in outfitting this asset. Microstrip fix radio wire used to send on board parameters of article to the ground while flight the aim of this is to design and fabricate a coaxial fed rectangular microstrip antenna and study the effect of antenna dimensions length, width and substrate parameters relative dielectric constant (rε), substrate thickness on radiation parameters of bandwidth and beam width. The early work of Munson on microstrip antennas for use as a low profile flush mounted antennas on rockets and missiles showed that this was a practical concept for use in many antenna system problems. Various mathematical models were developed for this antenna and its applications were extended to many other fields. The number of papers, articles published in the journals for the last ten years, on these antennas shows the importance gained by them. The micro strip antennas are the present day antenna designer's choice. Low dielectric constant substrates are generally preferred for maximum radiation. The conducting patch can take any shape but rectangular and circular configurations are the most commonly used configuration. Other configurations are complex to analyse and require heavy numerical computations. A microstrip antenna is characterized by its length, width, input impedance, and gain and radiation patterns. The length of the antenna is nearly half wavelength in the dielectric. It is a very critical parameter, which governs the resonant frequency of the antenna. There are no hard and fast rules to find the width of the patch. Low dielectric constant substrates are generally preferred for maximum radiation. The conducting patch can take any shape but rectangular and circular configurations are the most commonly used configuration. Other configurations are complex to analyse and require heavy numerical computations. A microstrip antenna is characterized by its length, width, input impedance, and gain and radiation patterns. Various parameters of the microstrip antenna and its design considerations were discussed in the subsequent chapters. The length of the antenna is nearly half wavelength in the dielectric. It is a very critical parameter, which governs the resonant frequency of the antenna. There are no hard and fast rules to find the width of the patch. Two microstrip patch antennas (MPAs) are presented, one is conventional MPA and another is metamaterial based MPA which is made by introducing three dual isosceles triangular slots on the copper patch of the conventional MPA. Metamaterial properties of the designed and proposed isosceles triangular slotted structure are investigated and proved as metamaterial by using Nicolson Ross Weir (NRW) approach. The proposed slotted structure exhibits double negative (DNG) property of metamaterial and the proposed metamaterial antenna shows improved bandwidth, greater directivity, lower return loss, comparatively more suitable VSWR than the conventional MPA. Microstrip patch antennas have made a great progress in the recent years. Compared with the conventional antennas, microstrip patch antennas have more advantages and better prospects. A microstrip patch design of a probe- fed antenna is presented for simultaneously Wireless Local Area Network (WLAN).The growth of wireless systems and booming demand for a variety of new wireless applications such as WLAN (Wireless Local Area Network), it is important to design broadband and high gain antennas to cover a wide frequency range. The design of an efficient wide band small size antenna, for recent wireless applications, is a major challenge. In applications like high performance aircraft, satellite, missile, mobile radio and wireless communications small size, low-cost fabrication, low profile, conformability and ease of installation and integration with feed networks are the main constraints. Also, with advancement of the technology, the requirement of an antenna to resonate at more than one frequency i.e. multi-banding is also increasing day by day. A rectangular microstrip antenna is conceived for a UWB system communication application, which is operating at a frequency of 4.1 GHz. The microstrip UWB antennas is one of the most commonly used antennas in radar applications. It has attracted a lot of attention because of their advantages such as ease of fabrication simple structure, easy integration with microwave integrated circuits. Geometric shape of a microstrip antenna comprises a radiating element on the dielectric substrate and on the other side a ground plane. There are several category of the microstrip patch antenna, can be cited some example the circular, a square radiating element, triangular, semi circular , but the most common is rectangular element. A lot of UWB antenna has been proposed since past years, but not many of them are compact in size. The FR4 is used as substrate material and the width of the substrate is 1.63 mm. The patch width is kept 0.035 mm. The width of the feed line is different over the whole feed line. On the backside of the antenna, the partial grounding technique is applied to triangular slots within the ground plane. The partial ground plane has an impact behind providing wide bandwidth. The triangular shaped microstrip patch antenna is designed and simulated under CST Microwave Studio environment. Partial ground is used for the antenna for grounding purpose. The triangular shaped slots are used to enhance the bandwidth for the antenna. In general an antenna is a part of transmitting or receiving system that can transmit or receive electromagnetic waves. There are different kinds of antenna that used in several applications. Some of them are: wire antenna, aperture antenna, printed antenna, array antenna, reflector antenna, and lens antenna. Among these antennas printed antenna is fabricated using photolithography technique. Most common version of the printed antenna is microstrip antenna. It is constructed using conventional microstrip fabrication technique. Microstrip antenna consist of a radiating patch on one side of a dielectric substrate and has a ground plane on the other side. There are three types in microstrip antenna. In the current years the improvement in communication system requires the advancement of ease, insignificant weight, low profile antennas that are equipped for keeping up good performance over a wide range of frequencies. The basic Microstrip patch Antenna comprises of a dielectric substrate having a fixed dielectric constant. Patch is present on one side of a dielectric substrate and a ground plane is available on opposite side of a substrate. The metallic patch may have any geometrical structures like rectangular, triangular, helical, ring, curved. The measurement of the patch resembles to the resonant frequency of antenna. But patch antennas have narrow bandwidth and the improvement of bandwidth is essential for most applications. So to increase the bandwidth diverse methodologies have been used. The design represented in this project has triangular slot cut on rectangular patch. In contrast with the previous design this design provides multi bands with more. directivity and other parameters. This design gives the flexibility to upgrade the parameters by changing the width and relative position of slot. Recently, planar antennas are used widely in the area of wireless communication for its various characteristics . The applications of planar antennas are in various fields such as in mobile communication, RFID applications, satellite and in the area of military such as rockets, aircrafts and missiles etc Microstrip patch antenna generally operates at their fundamental TM01 mode which produces a single beam. Microstrip patch antenna operating at higher order [TM02] mode has dual symmetric radiation beams . A wide-band and dual-beam U-slot microstrip patch antenna. There, two radiation beams were obtained by operating patch antenna at higher order TM02 mode instead of conventional TM01 mode and this antenna is suitable for indoor wireless systems. Slots in printed antennas are widely used for multiband operation. Some antennas for multiband applications, such as U-slot, V-slot and bow-tie slot have been reported. A variety of techniques have been used to achieve multiband operation for planar antennas. A printed triple-band and wideband dual-polarized meander-line monopole antenna is presented. In this design, a metamaterial loading concept is used which improves the impedance matching and causes the proposed antenna to radiate at multiple frequency bands with extended bandwidth.

2. METHODOLOGIES

The proposed triangular shape microstrip fix reception apparatus structured utilizing a Flame retardant material (FR4) having a dielectric steady of 4.3. What's more, this material is utilized as the substrate hachement feed of receiving wire. Figure 1 shows the structure of fundamental Microstrip fix receiving wire is stacked over the ground spot of copper. The same copper material is used as the patch ad feed of antenna..

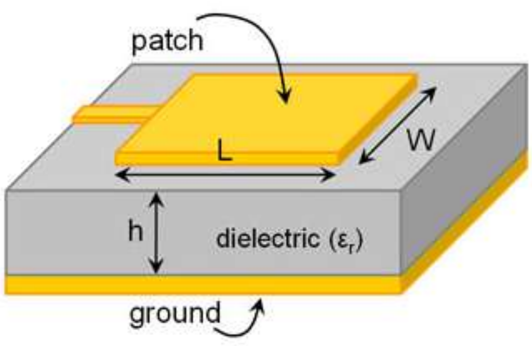

Fig: 1 Basic Microstrip patch antenna

Figure 2 shows the triangular microstrip patch antenna has a substrate made of FR-4 which has a dielectric constant of 4.3. The ground plane is made up of copper with annealed material which is placed one side of the substrate. The other side of substrate contains the patch that is made up of FR-4 lossy material. The proposed antenna is fed with microstrip line feed.

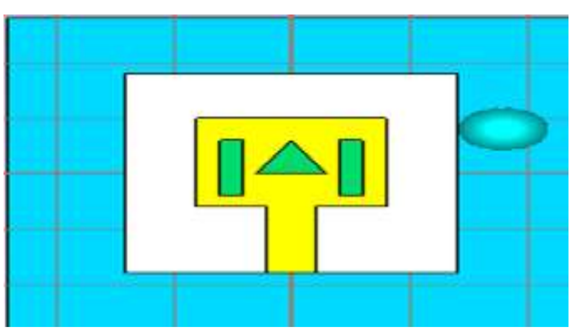

Fig: 2 Design of the proposed antenna

Sl.No	Antenna specifications	Dimension (mm)
1.	Thickness of the Ground	0.05
2.	Width of the Ground	14
3.	Height of the Ground	18
4.	Thickness of the Substrate	1.5
5.	Width of the substrate	14
6.	Height of the Substrate	18
7.	Thickness of the patch	2.95
8.	Width of the patch	8
9.	Height of the patch	8
10.	Thickness of slot1(left)	2.95
11.	Width of slot1(left)	5
12.	Height of slot1(left)	5
13.	Thickness of slot2(right)	2.95
14.	Width of slot2(right)	5
15	Height of slot2(right)	5
16.	Thickness of the feed	2.95
17.	Width of the feed	2
18.	Height of the feed	12
19.	Thickness of skin material	1
20.	Width of skin material	24
21.	Height of skin material	28
22.	Thickness of muscle	1
23.	Width of muscle	24
24.	Height of muscle	28
25.	Thickness of fat	1
26.	Width of fat	24
27.	Height of fat	28
28	Operating frequency	22.5 to 27.8 GHz

Table 1: Design specifications of proposed antenna

Table 1 shows the determinations of MPA. The length of the substrate is 18mm and width of the substrate is 14mm and the thickness of the substrate is 1.5mm from the beginning. The length of the ground plane is18mm and width of the ground plane is 14mm and the thickness of the ground plane is 0.05mm. The length of the fix is 8mm and the width of the fix is 8mm and the thickness of the fix is 2.95mm. The length of slot1 is 5mm and width of slot1 is 5mm and the thickness of slot1 is 2.95mm. The length of slot2 is 5mm and width of slot2 is 5mm and the thickness of slot2 is 2.95mm. The length of the feedline is 12mm and the width of the feed line is 2mm and the thickness of the feedline is 2.95mm. The length of the skin is 28mm and the width of the skin is 24mm and the thickness of the skin is 1mm. The length of the fat is

28mm and the width of the fat is 24mm and the thickness of the fat is 1mm. The length of the muscle is 28mm and the width of the muscle is 24mm and the thickness of the muscle is 1mm. The working recurrence is 22.5 to 27.8 GHz.

3. MATERIAL DESIGN

The skin material is having permittivity of 4 and penetrability of 1 for the recurrence scope of 22.5 to 27.8 GHz. The material thickness is 1100 kg/m^3. The fat material is having permittivity of 3 and porousness of 1 for the recurrence scope of 22.5 to 27.8 GHz. The material thickness is 940 kg/m^3. As far as possible is 0.01 and most extreme request is 4 for 3 GHz recurrence. The Muscle material is having permittivity of 1 and penetrability of 1 for the recurrence scope of 22.5 to 27.8 GHz. The material thickness is 1041 kg/m^3. As far as possible is 0.01 and most extreme request is 5 for 5 GHz recurrence.

Design equation Width of patch

$$W=c/(2f_0 \sqrt{((\varepsilon_r+1))/2})$$

Design equation Calculation of Effective dielectric constant

$$\varepsilon_{reff}=(\varepsilon_r+1)/2+(\varepsilon_r-1)/2\ [1+12\ h/W]$$

Calculation of the Effective length

$$L_{eff}=c/(2f_0 \sqrt{\varepsilon_{reff}})$$

The three important parameters for the design of patch antenna are as follows

- Operating frequency (f0)

The designed antenna must operate in the frequency range so the resonant frequency must be selected carefully in order to calculate antenna parameters.

- Dielectric constant

Here FR-4 material is used for substrate. The dielectric constant of this material is low. The low dielectric loss makes it worth for high frequency and broadband applications where dispersion losses are minimum. These materials are hydrophobic and highly isotropic.

- Height of dielectric substrate

In order to utilize the antenna for wireless devices the antenna should not be massive. So, the height of substrate is also an essential parameter. The following table gives the design parameters for the antenna:

- Resonant frequency= 10.46Ghz
- Dielectric constant=4.1
- Speed of light=3*108mm/s

Operating frequency range of C band is between 10.46 GHz to 20.25 GHz. It is also used for satellite and radar transmission. The C-band is used for many satellite communications and transmissions. Also it is used in some Wi-Fi devices, cordless telephones, and some weather monitoring radar systems. Portion of C band is used for TV broadcasting and reception systems and Wi-Fi networks.

4. RESULT AND DISCUSSION

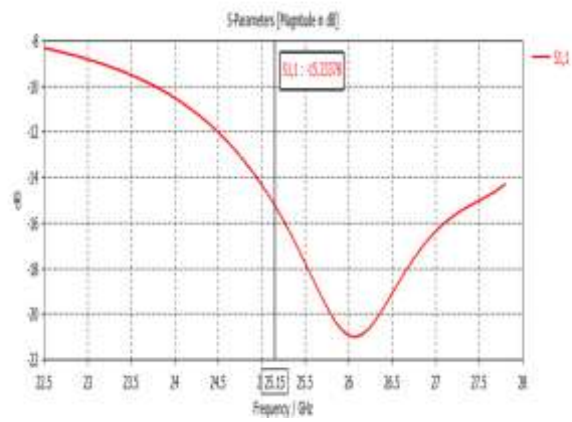

Fig: 3 Return loss of Triangular slot MPA

Fig 3 shows the return loss curve of the proposed antenna obtained by CST simulator. It was observed that the antenna has the return loss of -15.233dB resonate at the frequency of 25.15 GHz.

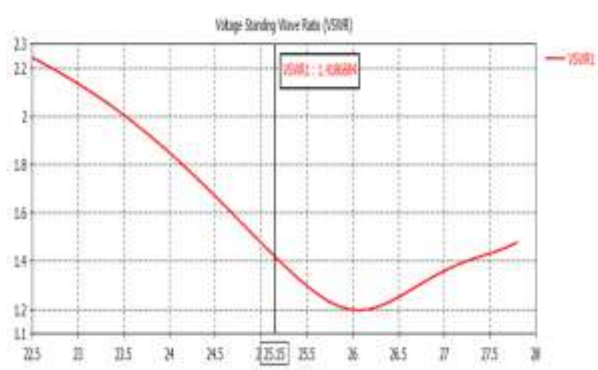

Fig: 4 VSWR of Triangular slot MPA

Fig 4 is the graph between VSWR and frequency. The graph clearly indicates that VSWR is less than 1.5 in the entire frequency band. The VSWR curve of the proposed

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antenna is obtained by the CST simulator. It was observed that the antenna has the VSWR value of 1.4186 resonate at the frequency of 25.15 GHz.

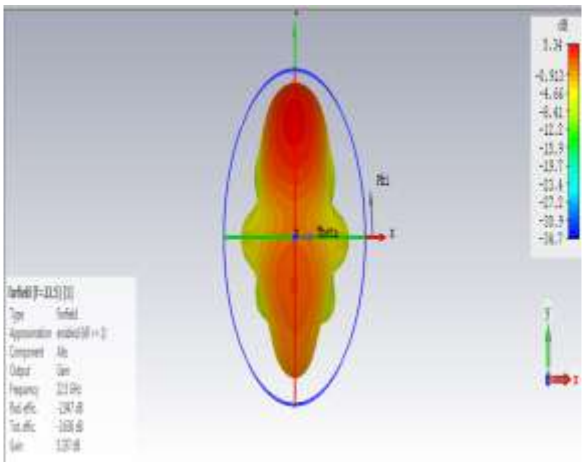


Fig 5 Gain of Triangular slot MPA at 22.5 GHz

Fig 5 shows the gain curve of the proposed antenna obtained by CST simulator. It was observed that the antenna has the gain of 5.34 dB at the frequency of 22.5 GHz

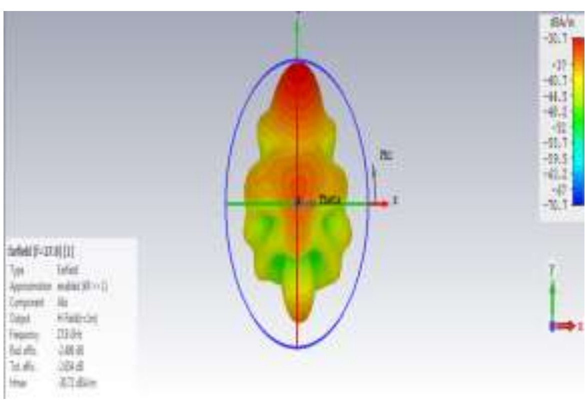


Fig 6 H-field of Triangular slot MPA at 27.8 GHz

Fig 6 shows the H-field curve of the proposed antenna obtained by CST simulator. It produces the H-field value of -30.7dBA/m at the frequency of 27.8GHz.

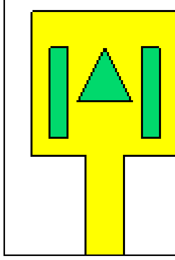
Antenna Type	Return Loss	VSWR
	-15.23	1.45

Table 2: Performance comparison of Microstrip patch antenna

The performance of the triangular slot microstrip patch antenna was evaluated by calculating various parameters like Return loss, VSWR, Directivity, E-Field.

Frequency	E-field	H-field	Gain	Directivity
22.5	19.4dBV/m	-32.1dBA/m	5.34dB	8.28dBi
25.15	20.3dBV/m	-31.3dBA/m	5.62dB	8.11dBi
27.8	20.8dBV/m	-30.7dBA/m	6.21dB	8.7dBi

Table: 3 Comparison Cmos & Gdi Properties

5. CONCLUSIONS

The triangular microstrip patch antenna using FR4 material' performance of the antenna were analyzed with various parameters such as gain, directivity, VSWR and return loss. From the performance analysis, provides gain(5.62), directivity(8.11), vswr(1.41) and return loss(-15.23). This antenna produce better results for c-band application. Simulated results illustrate that the proposed antenna could be a superior candidate for C band applications.

Future work involves the improvement procedures for the bandwidth of such antennas. Designs using diverse substrate and structure can be taken into deliberation for the future research. Different patches, dimensions and feeding techniques may also influence the performance of the antenna.

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