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Analysis of Two Inverted F-Shaped Antenna System with Highly Integrated T-Shaped Decoupling Structure

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Abstract: In communication systems, a small -shaped decoupling structure that can be highly integrated into a compact two-inverted-F-antenna(IFA) system is being used Each IFA is capable of operating in the 2.4 GHz and 5 GHz WLAN bands The height of the antenna is one of the deciding factor in antenna design It is inverted two times in F shaped antenna to ↑ gain and directivity In this project, we are going to propose two inverted F-shaped antenna The ultimate aim is to analyse the angle of degree and radiation pattern.Also, we propose the structure of antenna and gain impedance . The software tool which is used to analysis the performance is HFSS

Keywords: Monolithic Microwave Integrated Circuit (MMIC)

I. INTRODUCTION

In this paper, we present a novel single-patch wide- band microstrip antenna: the T-shaped patch antenna. When to parallel slots are incorporated into the antenna patch, the bandwidth increases above 30%. Compared to the U-slot microstrip patch antenna, the T-shaped patch antenna is simpler in construction. By only adjusting the length, width, and position of the slots, one can obtain satisfactory performances. Some experimental results prove the validity of this design. The method of moments with the vector triangular basis function is used for analysis, as well as HP- HFSS software. The electric currents on the pi-shaped patch are calculated and graphically presented to explain the wide- band mechanism. Subsequently, a wide-band inverted T-shaped patch antenna with 30.3% bandwidth is designed to cover both 2.6and 4.5GHz. These ranges of frequencies are very desirable in modern wireless communications. Radiation patterns are also measured and compared with the numerical data.

Antenna technology is advancing day by day the small antenna size with good performance are in high demand. Many conventional antenna structures such as Yagi, Parabolic Reflector, Helical, Horn etc. have wider bandwidth and gain but large size of these antennas restrict their use in various applications, so these antennas cannot be used in the devices which are smaller in size and are used as an moving object. To meet this requirement of wireless communication, microstrip antennas are widely used which satisfies the requirements of the wireless communication system.

The microstrip patch antenna is employed for the recent deployment in wireless communications such as radar, space communication, satellite communication, microwave and mobile communication etc.because of its light weight, low volume, low profile planar configurations, inexpensive and easy to integrate with microwave integrated circuits. Over the past two decades, microstrip patch antenna received attention for communication due to its advantages. Microstrip patch antenna has also disadvantages are narrow bandwidth, excitation of surface waves, low gain and depleted radiation pattern. Intensifier research has been carried out to overcome the cons of patch antenna. Different techniques with different shaped patch antennas are applied to increase the bandwidth and overcome the limitations.

Major challenges for efficient wide-band antennas are broad impedance bandwidth ($S_{11} < 10$ dB), flat gain response and less variation in group delay over the allocated bandwidth. Printed patch antennas are suitable for wide-band applications due to their excellent mechanical and electrical characteristics, compatibility for integration with other RF systems and mass production.

Microstrip patch antennas are presently under concern for using in broadband communication systems due to their attractive characteristics, such as low profile, low cost, lightweight, wide frequency bandwidth, ease of fabrication, and easy integration with monolithic microwave integrated circuits. However, the limitations of the microstrip patch antennas are having narrow bandwidth, and for that reason the demand of the bandwidth enhancement is gradually rising in the practical applications[1]. In order to enhance its bandwidth, many approaches have been applied conventionally, such as using thick substrates with low dielectrics constant, impedance matching network, parasitic patches stacked on the top of the main patch slots loaded on the patch, high dielectric constant substrate, and adopting short-circuit pin.

A rectangular slot antenna has been stated for dual frequency operation. A printed dipole antenna to cover dual band with t-slot arms has designed. In this paper, it has been reported a low cost microstrip dipole antenna for wireless communications[2]. A dual loop antenna for 2.4/5GHz wireless LAN. a monopole antenna with F has been stated in for 2.4/5.2GHz WLAN operations. A dual polarized antenna has been mentioned in for Ku-band application. Microstrip antennas on FR4 substrate material were discussed for UWB applications.

II. SYMMETRICAL F-SHAPED PATCH ANTENNA

Top views of the antenna and feeding parts of the proposed patch antenna are depicted in Fig. 1(a) and 1(b). One longitudinal slot and two transverse slots are etched on a rectangle patch to create a symmetrical i-shaped patch antenna, as shown in Fig. 1(a). This antenna is excited by a slot at the end of the SIW feeding network, as shown in Fig. 1(b). The slot is precisely under the longitudinal slot of the antenna. A matching via is used in the SIW to realize impedance matching between the feeding part and the antenna part[3]. The proposed antenna uses the two-layer Taconic TLY substrate with dielectric constant $\epsilon_r = 2.2$ and thickness $h_1 = 0.508$ mm for the feeding layer and $h_3 = 0.508$ mm for the antenna layer.

The two layers are bonded together using Rogers 4450 with thickness $h_2 = 0.1$ mm and dielectric constant $\epsilon_r = 3.4$. A side view of the antenna is depicted in Fig. 1(c). The proposed antenna dimensions are given in Table I. The main design principle of the proposed patch antenna is summarized into three points, as follows.

- 1) The slot coupling is utilized to excite multiple TM modes. The resonance frequencies of desirable modes (i.e., TM₁₀ and TM₂₀) are tuned to be sufficiently close to each other to broaden the impedance bandwidth. The longitudinal slot on the patch not only increases the resonance frequency of the TM₁₀ mode but also reduces the resonance frequency of the TM₂₀ mode.
- 2) The current and the E-field of the TM₂₀ mode are twisted using the longitudinal slot on the patch, so the antenna can achieve broadside radiation pattern based on both the TM₁₀ and TM₂₀ modes.
- 3) The undesirable modes (e.g., TM₁₂) are suppressed by the two transverse slots on the patch. Then, stable radiation performance can be realized in a wide designated bandwidth.

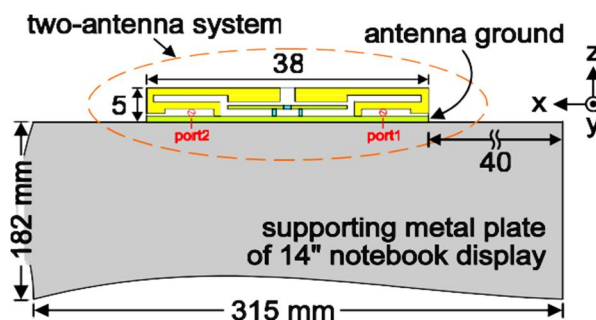


Figure 1 (a): Top view of Existing f shaped patch antenna

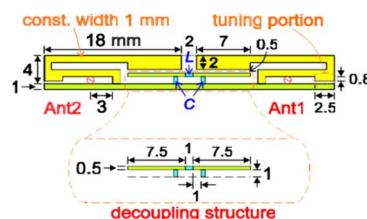


Figure 1 (b): Side view of the antenna part and feeding part

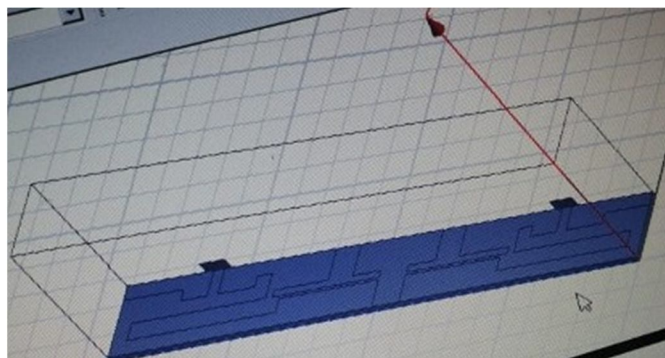
A. Antenna Design

A major constituent of a slot antenna is a metal surface (mostly a plan plate), with a slot or hole cut out. A folded antenna is a flat antenna with wide bandwidth and maximized at the broadside. It include with a folded slot as approximate circumference equal to one guide wavelength (an example of simple folded slot antenna). At the corner of shape we cut out the slit for the purpose of enhancing the bandwidth. T shapes folded slot cut on patch type antenna has width (w) and length(L).In this paper we used Roger RT/duroid 5880(tm) material with 2.2 dielectric constant and 4 mm thickness is used in substrate. This designing is simulated with Hfss 13 tool. In Fig. 2 we show the side view of antenna designing and figure 3 represent the Top view of antenna. Dimension of antenna is shown in below Ground size Length-56mm, Width -44mm. Substrate size length -56mm, width -44mm and height.4mm with dielectric constant 2.2. T shapes lower part slot length 35mm and width 4mm.upper part slot width 20.8mm.

III. PROPOSED T SHAPED MICROSTRIP PATCH ANTENNA

Normally pi shape antenna output 30-60GHz .we are propose Tshaped output is above 60GHZ. Parameter are below 10DB transverse slot. TM10 wave, TM20 wave feeding port bonding layer SIW transition line is 40 mm. The simulated total loss of the SIW transition line, the SIW to theGCPW and the connector is less than 0.65 dB in the working bandwidth .Other modes exist but result in exotic radiation patterns and have little -if any- practical use

Parameter	Material/value
Dielectric Material	Copper
Dielectric Medium	Vaccum
Loss Tangent	1.0×10^{-4}
Height of the substrate	1.6 mm
Width of the patch	12.5 mm
Length of the patch	12.5 mm
Resonance Frequency	4.5 GHz
Return loss	-20DB



2 a) proposed block diagram

IV. SIMULATION RESULTS

The simulation of micro-strip patch antenna is done by using HFSS simulation software. The VSWR graph for a back to back T shaped slotted rectangular patch antenna is shown in figure 6. The . The VSWR for T shaped slotted antenna is 2.00db. The simulated radiation pattern in 3D are shown in figure 7.

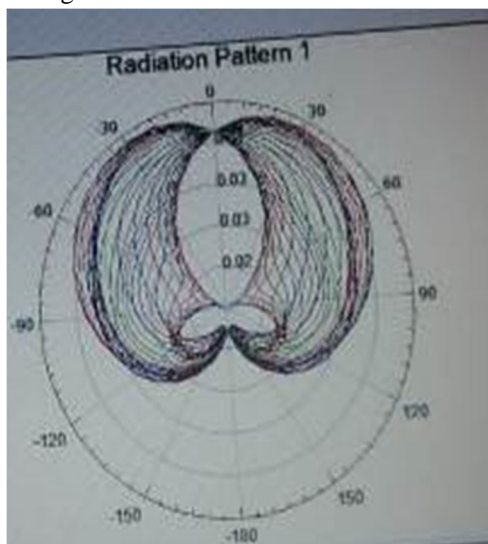


Figure 6: VSWR of the Proposed Rectangular Microstrip Patch Antenna with Back to Back T Shaped Slots

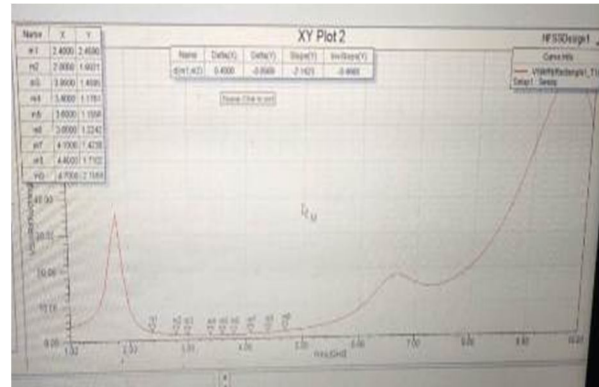


Figure 7: Radiation Pattern in 3D of the Proposed Rectangular Micro-strip Patch Antenna with Back to Back F Shaped Slots

V. CONCLUSION

We are propose new method t shape antenna . The height of the antenna is one of the deciding factor in antenna design It is inverted two times in F shaped antenna to \uparrow gain and directivity In this project, we are going to propose two inverted F-shaped antenna .The ultimate aim is to analyse the angle of degree and radiation pattern. Also, we propose the structure of antenna and gain impedance. Antenna properties was improved structure was simple .easy to fabricate .Unwanted to removed .communication to be improved .

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