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A Robust U Shape Microstrip Patch with Defected Ground Structure for Wi-Fi and Wi-Max Range

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ABSTRACT - In the last decade there are different shape and size microstrip patch antenna introduced for the enhancement of bandwidth in the antenna. In this paper discuss robust patch shape antenna for the enhancement of bandwidth of the antenna. The proposed robust U shape microstrip patch with defected ground slot is presented in this research article. The proposed antenna shows good return loss as well as shows good voltage standing ratio of 1 to 6 GHZ range. The proposed U shape antenna with DGS simulated on the CST studio. The current and energy distribution of proposed U shape antenna is also very good. The proposed antenna shows better result as compare to other previous U shape antenna on the basics of return loss (S-11), VSWR and radiation pattern of the antenna. The application range of proposed work is 2.86 GHz frequency and give return loss -45dB also shows good VSWR near to 1. The proposed antenna shows good bandwidth. The BW of proposed antenna is 2.489 is good as compare to the other U shape microstrip patch antenna.

***Keywords*—Bandwidth, VSWR, Return loss, CST, Wi-Fi and WiMax range.**

I. INTRODUCTION

With the motive for telecommunication, there came alternatives like drums, some visual methods for example smoke signals and signal flags etc. The optical communication equipment used the light (visible portion) of the electromagnetic spectrum as the medium with the help of optical fibers. With the advancement of the technology, the visible region of the electromagnetic spectrum has been occupied for communication, with the help of radio. One of the mankind's tremendous natural resource is the electromagnetic spectrum and important element for using this resource is antenna. [12] Wireless communication system has been advanced extensively and rapidly in the modern world particularly amid the last two decades. The future advancement of the personal communication structures will goal to provide image, speech and data communications at any time, and anywhere around the world. It signifies that the future communication transceiver antennas meet necessarily the requirement of multi-band and wideband to adequately include the feasible operating bands. Wireless operation allows the services, like tele-communications, that are preposterous to implement with the help of wires. The familiar benefits of wireless networks are to connect the laptop/mobile data communication users who navigate from location to location. Another important usage is for mobile networks that have a link through antennas, via satellite communications. Different modes of Wireless communication are:

1. RF communication
2. Microwave communication like long range line-of-sight high directional antennas and short range communications.
3. Infrared short range communication like remote controls.

The field of wireless communication has been experiencing a subversive hike in the last decade like 2G-cellular communication (portable mobile phones), 3G- Bluetooth, 4G- the mobile Wi-MAX standard and LTE standard, LAN.

II. U SHAPE MICROSTRIP ANTENNA

In U-Slot patch antenna originally the U-slot patch antenna was developed as a wide band antenna, introduced by Huynh and Lee. They also are good choices for multiband applications and circular polarization operation. Wireless

communication includes numerous kinds of mounted, mobile, and moveable applications, like two-way radios, cellular telephones, personal digital assistants (PDAs), and wireless networking. Different applications of radio wireless technology embody GPS units, wireless laptop mice, garage door openers, satellite TV, broadcast tv, keyboards and headsets, headphones, radio receivers, and wireless telephones. [01] [02] [03].

IEEE 802.11 could be a set of standards for implementing wireless native space network (WLAN) pc communication within the 2.4, 3.6, 5 and 6 GHz bands of frequency. They're enforced and maintained by the IEEE LAN/MAN Standards Committee. The 802.11a normal uses an equivalent circuit layer protocol and frame format because the original commonplace. It works in the 5 GHz band with a most net data rate of 54 Mb/s, plus error correction code, yielding realistic internet realizable turnout within the mid-20 Mb/s. Since the 2.4 GHz band is heavily wont to the purpose of being excessively crowded, exploitation the comparatively unused 5 GHz band provides 802.11a a big advantage. In theory, 802.11a signals are absorbed additional promptly by walls and different solid objects in their path due to their smaller wavelength. 802.11a conjointly suffers from interference, but regionally there is also fewer signals to interfere with, therefore resulting in less interference and higher throughput. In this presented work shows that U-Shape microstrip patch antenna (U-MSA) designed. In this antenna slotted and different dielectric constant is also used to enhance the return loss (S-11) and voltage standing wave ratio (VSWR), U shape micro-strip antenna has become widespread day by day the explanation behind this can be simple analysis and fabrications. U shape micro-strip antenna is designed for Giga hertz frequency range 1 to 6 GHz where this frequency range accommodate in the various band in the1.09, 2.6,4.8 and 3.55 are in GHz range frequency spectrum and radiate wave. U shape Microstrip patch antennas have importance in the applications of Wireless Local Area networks (WLAN) and Wi-Max range in between 1 to 6 GHz. The proposed design and its different parameters are shown in this chapter also discuss the various steps to design the proposed antenna. [04] [05] [06]

III. PROPOSED DESIGN

Proposed U Shape Micro Strip Antenna (U-MSA)

In this section discuss the proposed method view and explain design structure of the microstrip patch antenna. A explain the U shape patch antenna with microstrip feed line and triangle cuts and ground to reach bandwidth along with much gain and as substrate used FR-4 (ε_r-4.4). The main target of proposed work is work is to design efficient U Shape Patch antenna for 1 to 6 GHz for this used a different substrate material and simulate on CST. Micro-strip Patch Antenna, and effect of different substrate and its dimensions Length (L) (66mm) , Width (W) (112) and Height(H) (1.6) and substrate parameters relative Dielectric constant (4.4) to (ε_r-4.4),

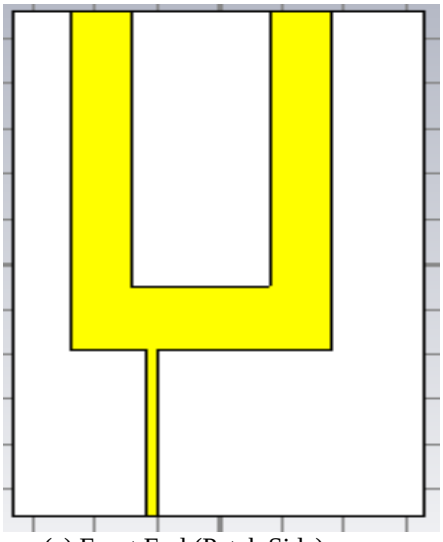
Table.1 Dimension of Antenna Design

S. No.	Parameter	Dimension (m.m.)
1	Substrate	66X112X1.6
2	Ground	(66X34) –Sub. of T cuts
3	Patch	42X75) - (22X61)
4	Feed Line	2X37
5	Feed type	Microstrip feed Line

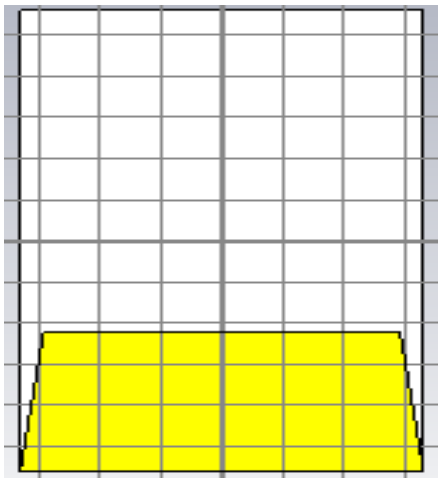
In the table 1 shows the all parameter of antenna design specification of proposed antenna. In this antenna substrate dimension are length (L), width (W) and height is 48mm, 40mm and 1.6 mm. The dimension of ground is 66 mm and 112 mm is used, then reduces the size of ground and apply two triangle cuts on ground and make a defected ground structure in this proposed antenna. The dimension of ground in which design the U-MSA which is made by the combination of different shapes which in deeply describe in the next section.

Design of proposed U-Shaped MSA with Right Angle Cut on Ground Antenna:

The optimum parameters are determined by many simulated results to achieve the design of proposed antenna. The design is simulated on computer simulated technology (CST). Figure 1 shows the 2-D diagram of rectangular antenna shape of proposed antenna.



(a) Front End (Patch Side)



(b) Back End (Ground Level)

Fig. 1 Geometry of proposed U Shaped Patch antenna

The structure of the proposed antenna is chosen to be a rectangular plate member with the dimension length L and a width W. L sub and W sub are the size of the substrate and Lg Wg are the length of the base surface, the width of base surface, respectively. The dimension of base surface and dimension of substrate are approximately equal. In this design radiating element is excited by micro-strip feed. Patch dimensions are calculated by using broadcast line model. The above figure 1 shows the structure of the antenna.

To design a rectangular micro-strip patch antenna according to parameters such as di-electric constant (εr), the resonance frequency (f_o) and the height (h) are taken into consideration for the calculation of the length and width of the room.

IV. SIMULATION AND RESULT

In this section discuss the simulation and result of the proposed antenna. For analyzed the performance of proposed antenna important aspects are return loss (S-11), voltage standing wave ratio (VSWR) and energy distribution. First discuss the S -11 parameter of proposed antenna.

S -11 Parameter (-55db) – It is the power loss in the signal that is reflected due to discontinuity in the transmission line. As we already know, when impedance matching between the transmitter and antenna is not perfect, the radiations within the substrate results into the standing waves. In the below figure shows the S-11 result of proposed U shape patch antenna. Figure 2 shows S- 11 result of the proposed design,

VSWR – Voltage standing wave ratio is also one of the most important parameter for performance calculation of proposed antenna. In the below figure shows the VSWR graph. In the graph clearly show the VSWR graph of the proposed antenna of given range is lie in between 1 to 2 in the range 1.1 to 4 GHz. Figure 3 discuss VSWR of the proposed antenna.

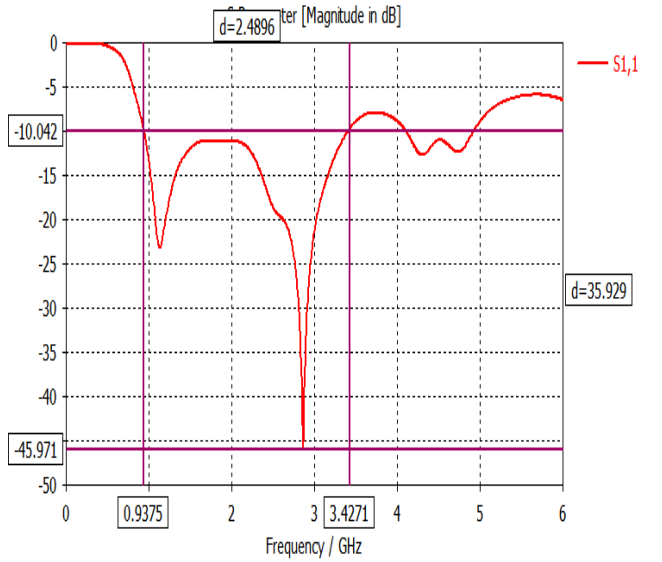


Fig. 2 Shows S-11 of U shape patch antenna

I n the above result clearly see that return loss is near about -45 dB. -45 dB is good value of return. After that discus the VSWR of the proposed antenna.

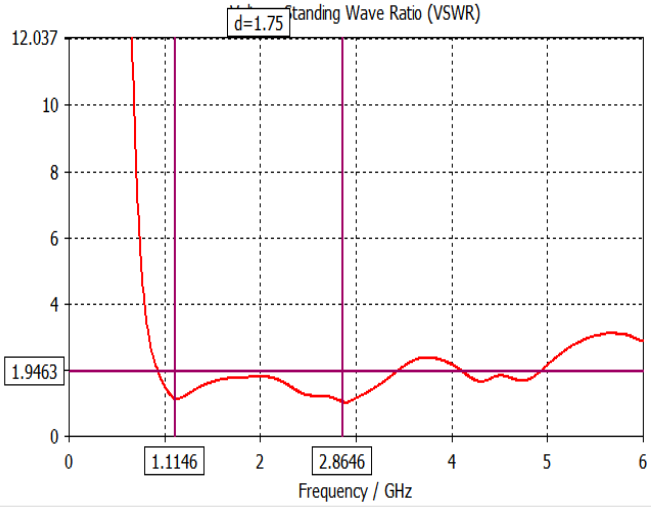


Fig. 3 VSWR Parameter on proposed design

Above figure 5.2.9 shows the voltage standing wave ratio of proposed antenna. In the idea case VSWR in between 1 to 2. The output of proposed antenna in case VSWR overall result is good in both resonant frequencies 1.09 and 2.86. Now discuss the far field pattern in which discuss different radiation patterns.

Polar Plot and Smith Chart

Now discuss the Polar chat and smith chart of the proposed U shape antenna. For the analysis of the

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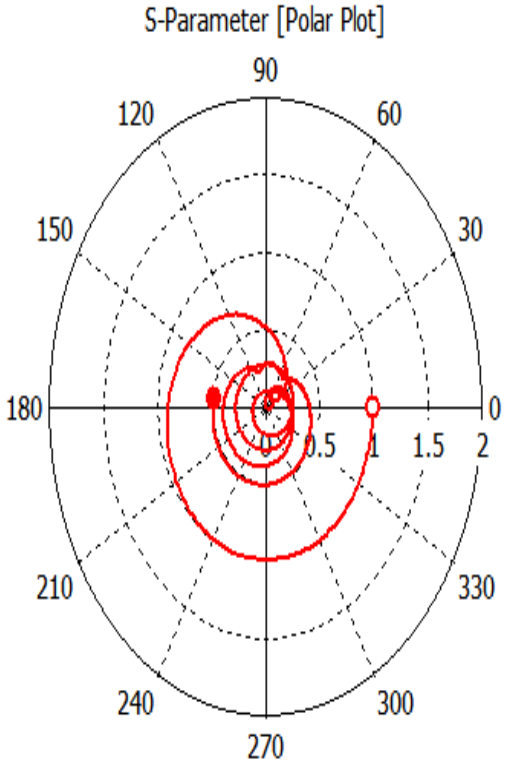
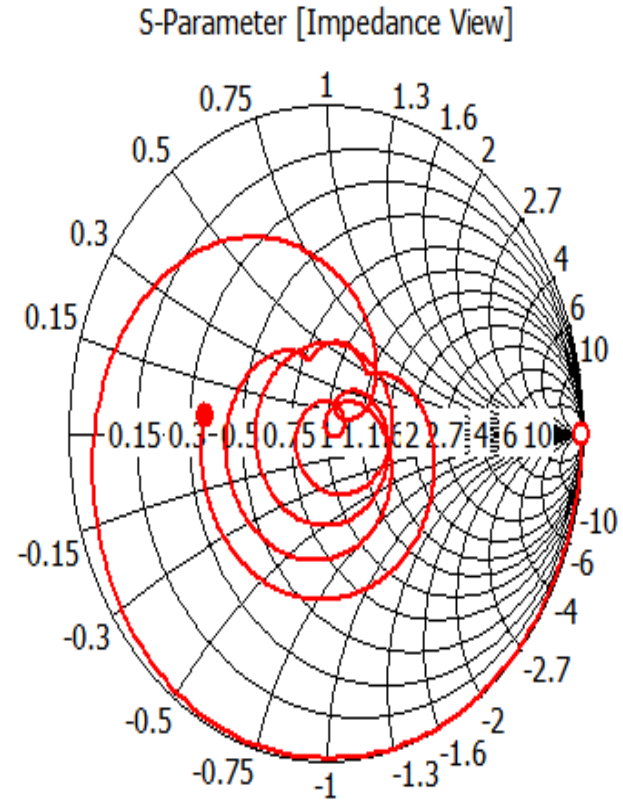


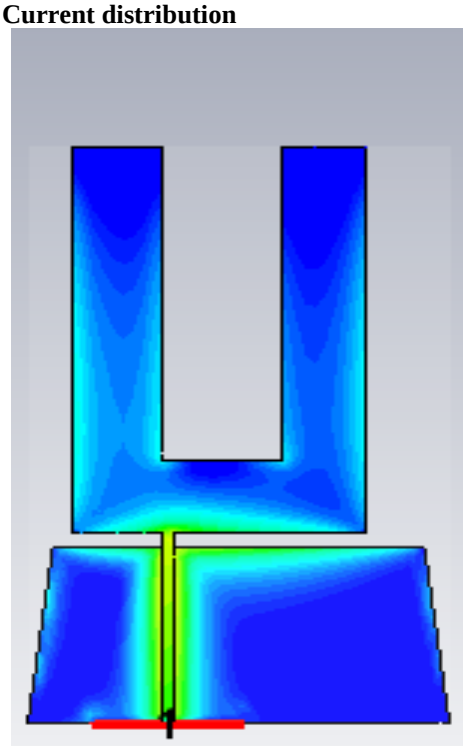
(a) Polar plot of the proposed design -1



(b) Smith Chart of the proposed design antenna -1

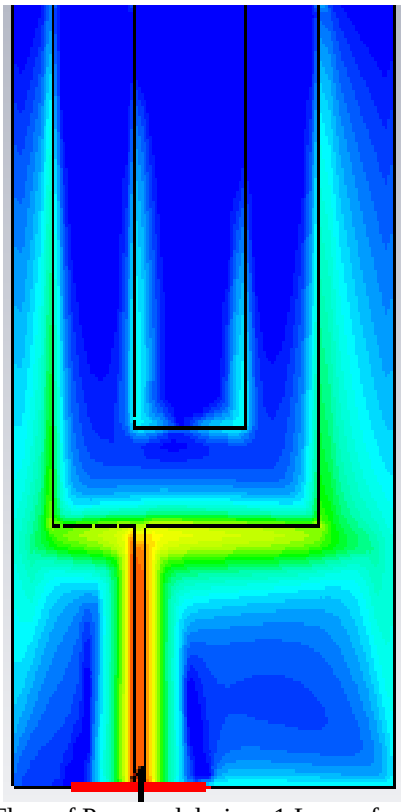
Fig. 4 Polar Plot and Smith Chart of proposed U Shape

Surface Current distribution



(a) Surface Current Distribution of Proposed design -1

Power Flow

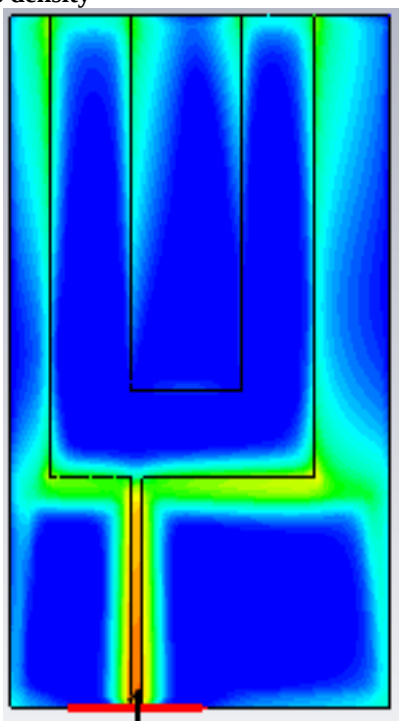


(b) Power Flow of Proposed design -1 Lower frequency

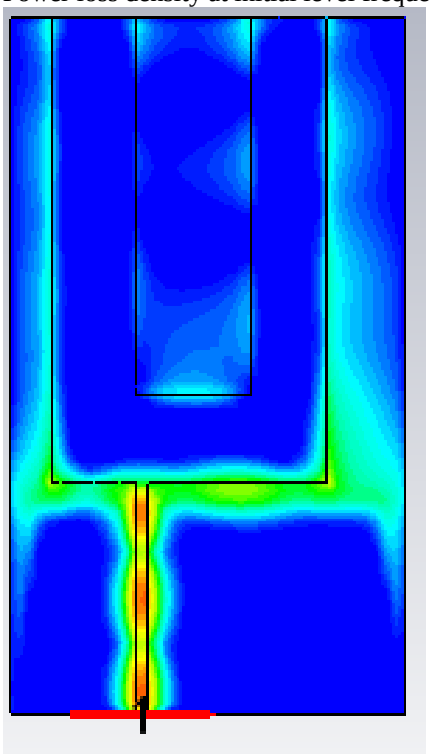
Fig. 5 (a) Surface Current Distribution and (b) Power Flow of Proposed design

Both figure shows the power flow of proposed design in different area that is derbies in the above figures.

Power Loss density



(a) Power loss density at initial level frequency



(b) Power loss density at final level frequency

Fig. 6 (a) Power loss density Initial and (b) Power loss density at final level

Both figure shows the power loss density of proposed design in different area that is derbies in the above figures.

3D result of proposed design-1

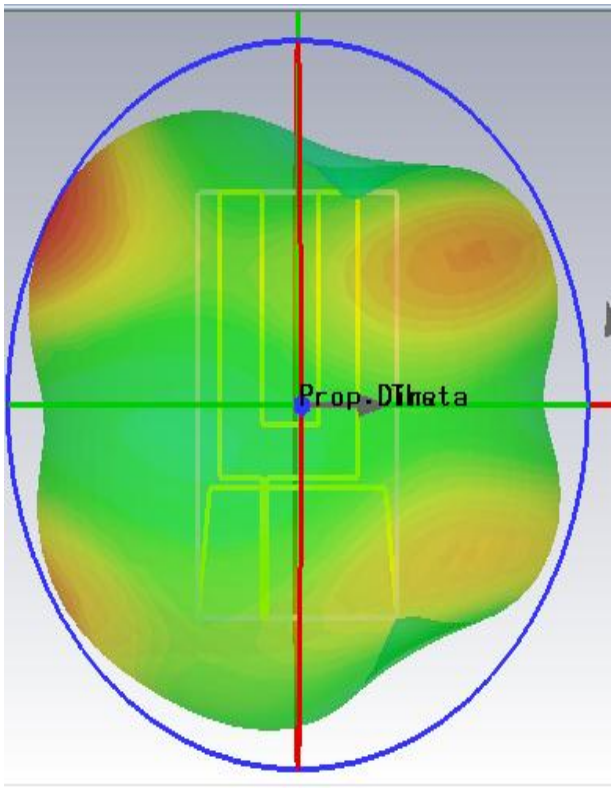


Fig. 7 3D Pattern of Far Field (f=2.84GHz)

In the above figure shows far field pattern there are five different far field generated in radiation pattern one by one shows. In the above figure shows **Cal. Directivity is 3.299dBi.**

IV CONCLUSIONS

In this proposed work present a U shaped micro-strip patch antenna defected ground structures designed, simulated, and tested for wireless applications. Antenna structure with and without defected ground plane are presented and compared. The measured and simulated resonant frequencies of the modes and respective impedance bandwidths of the patch antennas were observed to be in good agreement. The difference between the bandwidths at different frequency bands is small, which is an attractive feature. The gain values at the operating frequencies of novel structure are also measured. Measured and simulated radiation patterns are in good agreement. This study elucidates the tradeoff between compactness through DGS with gain. The proposed antenna is applicable for wireless communication systems with enhanced bandwidth especially working in Wi-max and wireless application. These results shows antennas could be developed for possible applications in several wireless systems like WLAN and Wi-MAX if

properly scale to the allowed frequency bands as well as research for the Military Field. This proposed antenna is very useful in point to point communication area. This designed antenna is for high power, radio frequency (R.F.) efficient radio equipped to transmit over entire frequency between the ranges of 1 to 6 GHz frequency also which is also compatible for OFDM and 3G and 4G range like TDLTE communication. [19]

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