ISSN: 2321-8169
3032 – 3035

Dual and triple band microstrip feed antennas using U slot technique for GSM and WLAN

Menka Singh (PG student)
Electronics and Telecommunication dept., VIT
Vidyalankar Institute of Technology , Wadala, Mumbai
menka.singh@vit.edu.in

Prof.Shraddha Panbude (Guide)
Electronics and Telecommunication dept., VIT
Vidyalankar Institute of Technology, Wadala, Mumbai
shraddha.panbude@vit.edu.in

Abstract— We propose dual-band and triple- band rectangular patch antennas with microstrip feed. The U-slots technique is used to design dual-band and triple- band antennas .The presence of U- slot is in the patch introduces a notch into the same matching band, resulting in a dual band antenna . If another U-slot is etched on the same patch it results into a triple-band antenna. In this paper the U slot method is utilized to achieve dual and triple band rectangular patches with microstrip feed for WLAN and GSM applications. We also demonstrate the effect of changing the size of the ground plane on the return loss of an antenna.

Keywords- **(Microstrip antennas; Dual band; Triple band; U-slots method)**

*****

I. Introduction

In planar ultra-wideband antennas, it has been found that the presence of a U-slot introduces a band notch, and this has been utilized to minimize interference [1-2]. By cutting U-slots in the patch, notches are introduced within the matching band, resulting in multi-band operation [3-4]. The U slot patch antennas can provide 25-30 % increase in impedance bandwidth for air –substrate and 20% for microwave substrate of similar thickness [5] . Broadening the antenna bandwidth is achieved by using the U-slot technique .In previously done research on the conventional U-slot etched microstrip antenna, the effect of the U-slot is on the performance of a patch antenna over the achieved bandwidth [6].

However, in microstrip patch antennas, the U-slot was mainly used for bandwidth enhancement rather than introducing a band notch. This technique is applied for the rectangular microstrip feed patch antennas in this article. We demonstrate that the U-slot technique can be used to design dual-band and triple-band characteristics microstrip fed patch antennas. Initially the wideband patch antenna with infinite ground plane is designed and later the size of the ground plane is reduced. The three different antennas and their experimental results are mentioned in section 2and the conclusion for the proposed work is described in section 3.

In the section 2 the antenna design and its results are discussed and concluding remarks are given in section 3 respectively.

II. Designed Antennas

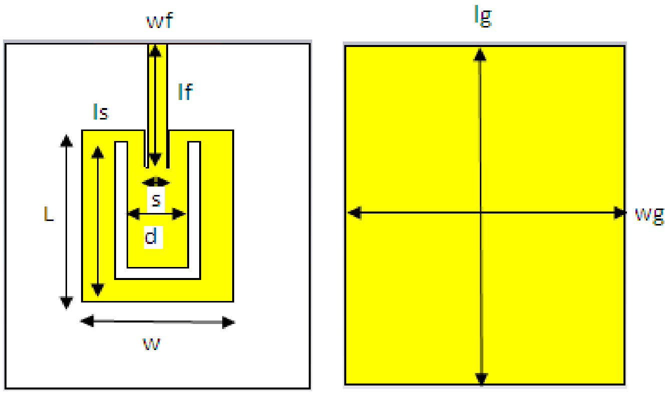
The geometry of the proposed dual band microstrip fed patch antenna is mentioned in this section . The U slot is etched on the patch of the proposed antenna. The antenna is printed on FR4 substrate with dielectric constant 4.4 and thickness 1.529 mm. The basis of the proposed antenna structure is a rectangular patch which has dimensions of length L and width W, and connected at the end of the CPW feed-line.

The Antenna simulations were performed using software Computer Simulation Technology (CST STUDIO SUITE). CST Microwave Studio is based on Finite Integration Technique (FIT) for general purpose electromagnetic simulations.

A. Antenna 1 with infinite ground plane for Dual Band

Initially considering the ground plane of the proposed antenna as infinite ground plane as shown in figure 2.1. The geometric parameters of the proposed antenna are: length of rectangular patch L= 30 mm, width of rectangular patch W= 25 mm, feed-line width Wf = 3 mm, feed-line length lf = 21 mm, with an inset of 6 mm and the space between the feed and inset is S =0.5 mm on both sides, slot length ls = 22 mm, slot width Ws =2 mm.

The dimensions of the ground plane is length of ground is Lg =60 mm and width of ground Wg = 50 mm respectively.



Top view (Patch) Bottom view (ground)

Figure 2.1: The top and bottom view of antenna 1

Figure2.2 shows the return loss v/s frequency of antenna 1, where the U slot introduces a notch at around f_1 =2.48 GHz and another notch is introduced at around f_2 = 4.8 GHz. The resulting dual band antenna have a frequency ratio $f_2/f_1 = 2$. The bands obtained in antenna 1 can be used in WLAN applications (2.4 GHz and 4.9 GHz)

ISSN: 2321-8169
3032 – 3035

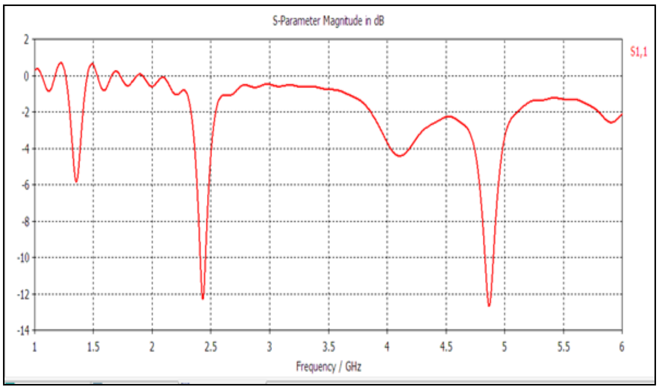
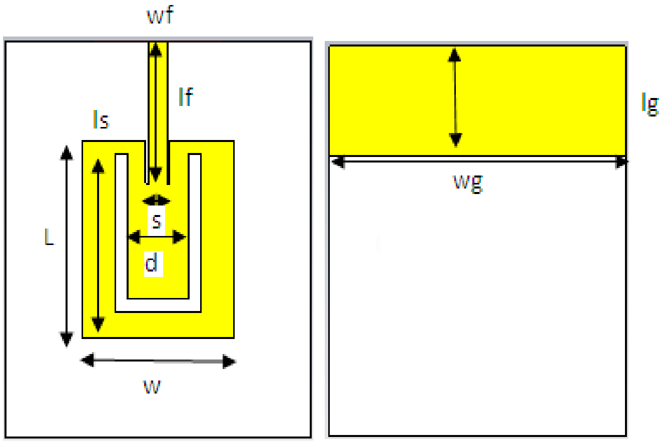


Figure 2.2: Return loss V/s frequency of antenna 1.

The return loss of -12.05 dB and -12.8 dB is obtained at 2.48 GHz and 4.8 GHz respectively as shown in figure 2.2.

B. Antenna 2 with reduced ground plane for Dual Band

We now decrease the length of the ground to Lg= 17mm and width Wg =50 mm respectively keeping all the other parameters the same.



Top view (Patch) Bottom view (ground)

Figure 2.3: The top and bottom view of antenna 2

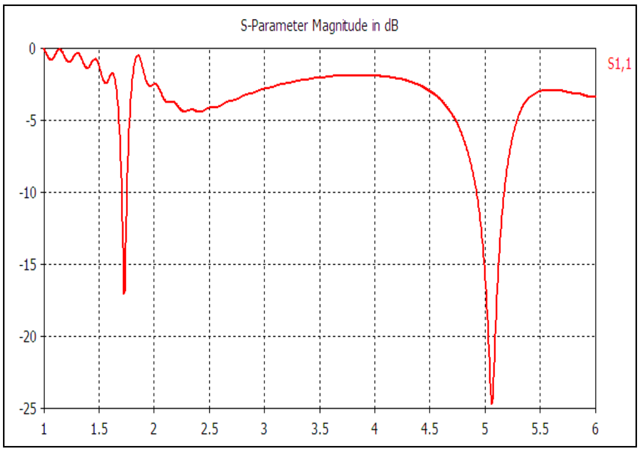


Figure 2.4: Return loss V/s frequency of antenna 2.

Figure2.4 shows the return loss v/s frequency of antenna 2, where the U slot introduces a notch at around f_1 =1.75 GHz and another notch is introduced at around f_2 =5.08 GHz. The resulting dual band antenna have a frequency ratio f_2/ f_1 = 2.91. The first band can be used in GSM 1900 applications, and second band for WLAN applications.

The return loss of -17.5 dB and -25 dB is obtained at 1.75 GHz and 5.08 GHz respectively. Thus by reducing the size of the ground plane, the return loss of the antenna is improved around 25 -30 %, Also the notches introduced by the U slots are shifted to 1.75 GHz and 5.1GHz.

The initial assumption in designing antenna 1 was an infinite ground plane as shown in figure 2.1.From the further simulations it was observed that as the size of the ground plane is reduced the bandwidth is increased as the return loss improves.

Figure 2.5 and figure 2.6 shows the directivity of the antenna 2. The directivity is 4.2 dBi at 5Ghz and 3.2 dBi at 1.75 GHz. Also the gain is 3.6 dB at 5GHz and 2.8dB at 1.75GHz respectively. The bandwidths is 278 MHz at % GHz and 50 MHz at 1.75 GHz.

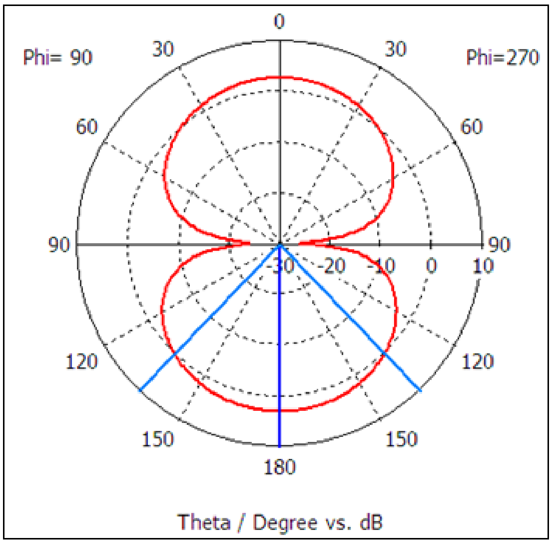


Figure 2.5: Far field radiation pattern of proposed antenna 2 at 1.7 GHz.

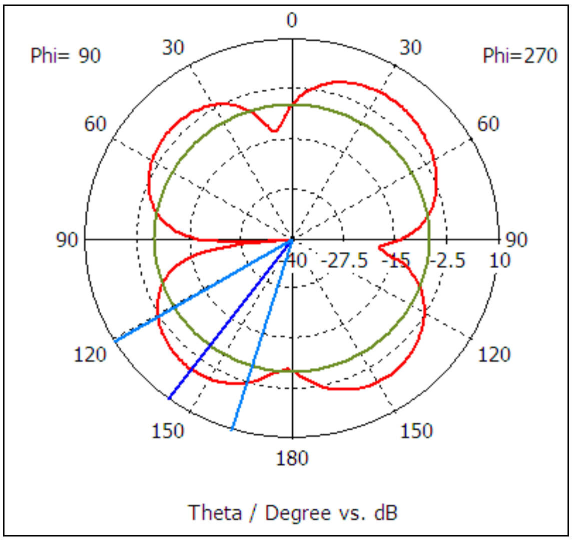


Figure 2.6: Far field radiation pattern of proposed antenna 2 at 5 GHz.

ISSN: 2321-8169
3032 – 3035

C. Antenna 3 with reduced ground plane for TripleBand

The proposed antenna 3 has the same dimensions as antenna 2 with an additional U slot etched on the patch.The Figure 2.7 shows the top and bottom view of the proposed antenna 3. The length of slot 2 is l_{s2}= 22 mm , width of the slot isWs= 2mm and the gap between slot 1 and slot 2 is 2mm. The width of the ground is lg= 17mm and width Wg =50 mm respectively.

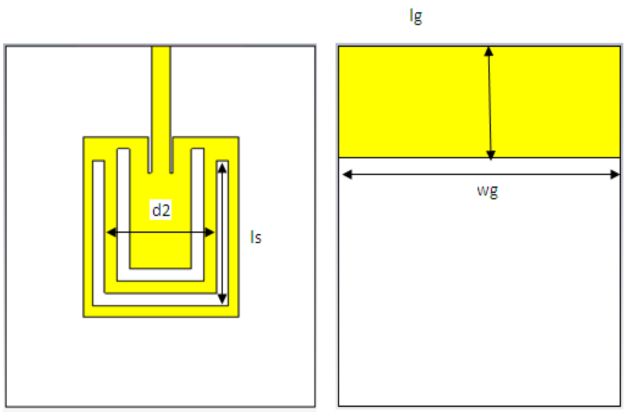


Figure 2.7: The top and bottom view of antenna 3

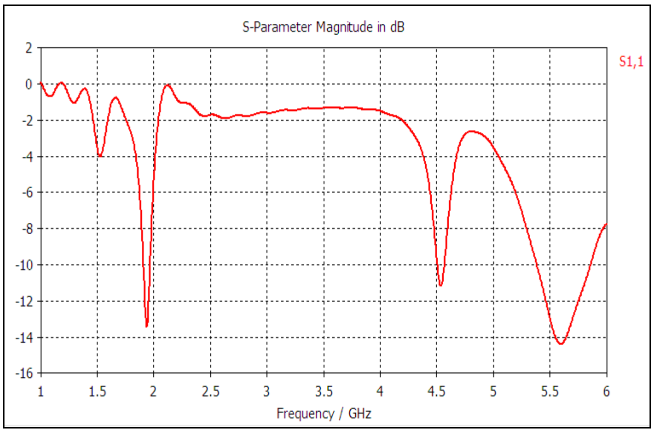


Figure 2.8: Return loss V/s frequency of antenna 3.

Figure2.8 shows the return loss v/s frequency of antenna 3, where the U slots introduces the notches at frequency f_1 =1.9 GHz, f_2 = 4.5 GHz and the third notch is introduced at around f_3 =5.58 GHz. The bandwidths is 278 MHz at % GHz and 50 MHz at 1.75 GHz.

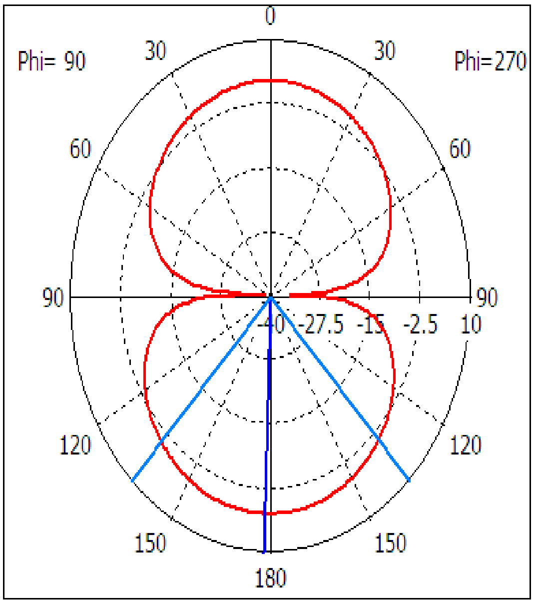


Figure 2.9: Far field radiation pattern of proposed antenna 3 at 1.9 GHz.

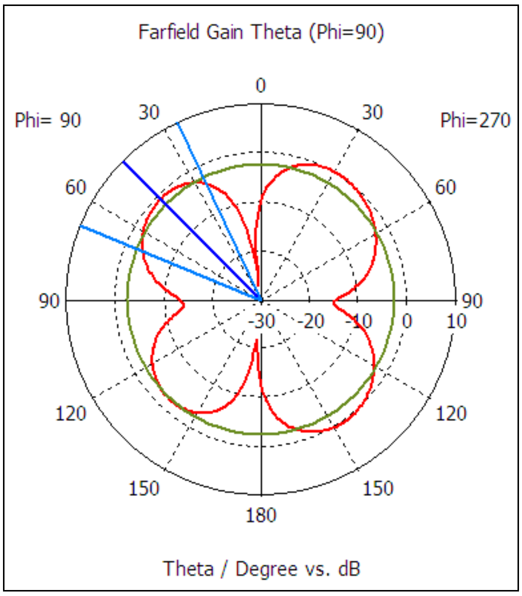


Figure 2.10: Far field radiation pattern of proposed antenna 3 at 4.5 GHz.

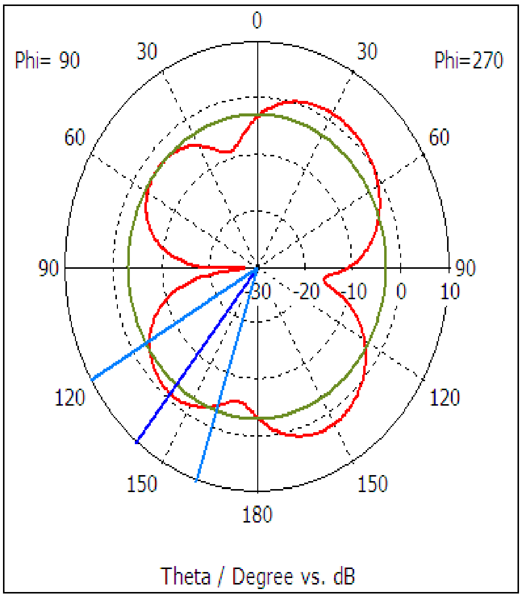


Figure 2.11: Far field radiation pattern of proposed antenna 2 at 5.58 GHz.

III. CONCLUSIONS

The U slot technique is described to design dual and triple band rectangular patch antennas with microstrip feed. The microstrip feeds can be easily matched with radiating patch and can be easily fabricated The bands obtained from antenna 1 can be used in WLAN applications at 2.4 GHz and 4.9 GHz.Also its has the disadvantage of high return loss and narrow bandwidth, which was overcome by antenna 2 by reducing the size of ground plane. The bands obtained from Antenna 2 and Antenna 3 can be utilized in different communication applications such as GSM (1.8-1.9 GHz) and WLAN applications (2.41-2.48 GHz and 5.25-5.75 GHz). In addition, the design technique is simple ,compact and easily realized with rectangular microstrip antenna fabrication, making it suitable for different wireless communication applications.

REFERENCES

[1] S. W. Su, K. L. Wong, and F. S. Chang, "Compact Printed Ultra-Wideband Slot Antenna with a Band-notched Operation, " Microwave and Optical Technology Letters, 45, 2, April 2005, pp. 1 28- 1 3 0 J.

[2] W. S. Lee, W. G. Lim, and J. W. Yu, "Multiple Band-Notched Planar Monopole Antenna for Multiband Wireless Systems, " IEEE Microwave and Wireless Components Letters, 15, 9, September 2005, pp. 5 76-5 7 8

[3] Y. M. K. Chyng, J. Kim, and J . Choi, "Wideband Microstrip-Fed Monopole Antenna Having Frequency Band-Notch Function, " IEEE Microwave and Wireless Components Letters, 15, II, November 2005 , pp. 766-768 .

[4] K.F.lee, K.M.Luk, K.M.Mak, “On the use of U slot in the design of dual and triple band patch antenna ”, *IEEE Trans. Antennas Propag., vol. 53, no. 3,June 2011.*

[5] K . F . Tong, K. M . Luk, K. F. Lee, and R. Q. Lee, " A Broadband U-Slot Rectangular Patch Antenna on a Microwave Substrate, "IEEE Transactions on Antennas and Propagation, AP-48, 6, June 2000, pp. 954-960.

[6] Ahmed Khidre, Kai-Fong Lee, Atef Z. Elsherbeni, and Fan Yang, “Wide Band Dual-Beam U-Slot Microstrip Antenna’’, IEEE Transactions On Antennas and Propagation, Vol. 61, No. 3, March 2013