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U Slot Loaded Wideband Rectangular Microstrip Patch Antenna for Wireless Applications

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Abstract: This study present a simple and slotted wideband microstrip patch antenna for wireless communication system. A U-shape slot has been loaded for design of the rectangular microstrip antenna. Doing this the bandwidth of antenna is improved upto 25.80%. The frequency of the proposed antenna design lie in the range of 1.847-2.394 GHz. This frequency band is suitable for wireless communication applications. The narrow bandwidth is major disadvantage of microstrip patch antenna hence this study provide an alternative solution for increase the bandwidth. The maximum gain of this designed antenna has been enhanced up to 3.11 dBi and radiation efficiency is 95.61%. A microstrip line feed of 50 Ω has been used in this proposed slotted microstrip antenna. The simulation process has been done by IE3D simulation software tool.

Key words: U slot, band width, compact, microstrip patch, microstrip line feed, frequency

INTRODUCTION

The demand of compact microstrip antennas with high gain and wideband operating frequencies has been increased for development of wireless communication system. Microstrip patch antenna possesses many advantages such as low profile, light weight, small volume and compatibility with Microwave Integrated Circuit (MIC) (Surjati *et al*., 2010). The narrow bandwidth and small gain are the major disadvantages of microstrip antenna. The bandwidth of microstrip antenna can be enhanced by loading U slot in radiating patch (Khan and Chatterjee, 2016). The antenna radiating patch is directly feed through 50 Ω microstrip line feed. The frequency band of proposed antenna is lies in between 1.847-2.394 GHz which is suitable for wireless communication applications (Zade and Choudhary, 2011; Hu *et al*., 2011; Roy and Bhunia, 2012). The size and bandwidth of microstrip antenna also depends on substrate material. On increasing the dielectric constant, the size of antenna decreases as well as bandwidth and efficiency also, decreases.

Antenna design specifications: The proposed antenna design is shown in Fig.1. A glass epoxy used as substrate of a dielectric constant 4.4 is used in this antenna design (Balanis, 2005). The patch width and length are 30 and 40 mm, respectively. The design has ground plane width 40 and length 50 mm. The dielectric substrate height is 1.6 mm and 0.0013 is used as loss tangent. Radiating patch is fed through 50 Ω microstrip line feed. IE3D simulation software tool has been used for simulation work. All the specifications are given in Table 1 and 2.

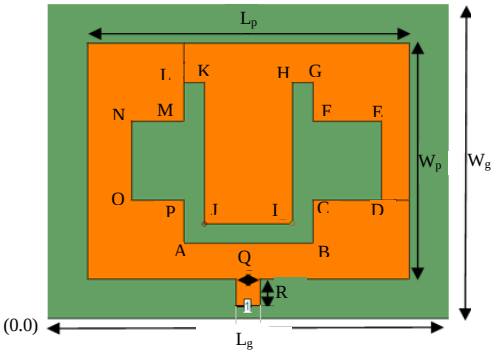

Fig. 1: Geometry proposed microstrip antenna

Table 1: Antenna design specifications

Parameters	Values (mm)
Dielectric constant ε_r	4.4
Substrate height h	1.6
Patch width W_p	30
Patch length L_p	40
Ground plane width W_g	40
Ground plane length L_g	50
Length of feed strip Q	3
Width of feed strip R	3

Table 2: Antenna parameters

Parameters	Values (mm)
AB	16
BC, PA	5.5
CD, EF	8.5
DE, NO	10
EF	8.5
FG, LM	5
GH, KL	2.5
HI, JK	18
IJ	11
MN	6.5
OP	5.5

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MATERIALS AND METHODS

Antenna design procedure: Figure 1 shows the design of proposed U slot loaded microstrip antenna. In designing of proposed antenna on IE3D tool ground plane is selected from (0, 0) at lower left corner. The microstrip line feed of 50 Ω is placed at lower middle of the patch through a strip of length 3 and width 3 mm to achieve maximum bandwidth.

RESULTS AND DISCUSSION

This study shows the enhancement of bandwidth of rectangular microstrip patch antenna by loading U-slot. The fractional bandwidth of proposed antenna is 25.80% and antenna is resonating at 2.203 GHz with return loss-34.91dBi. The experimental bandwidth of microstrip antenna is 21% in the frequency range 1.960-2.420 GHz and resonance frequency at 2.070 GHz with return

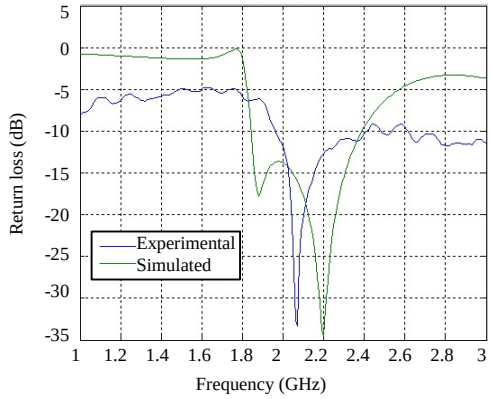

Fig. 2: Return loss v/s frequency graph

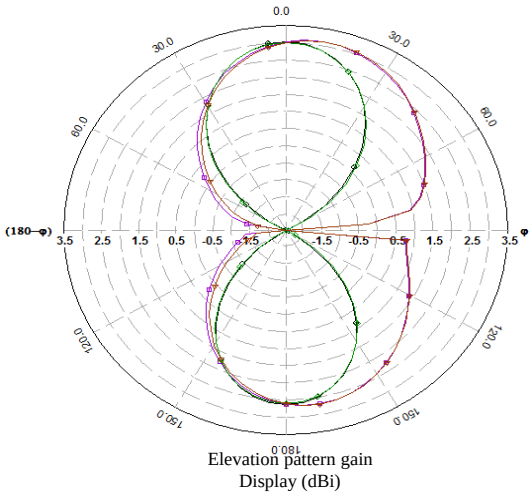

Fig. 3: 2D Radiation pattern of proposed antenna

3.31 dBi and 3 dB beam width of the proposed antenna is loss-33.36 dBi. The efficiency of proposed antenna is found to be 95.61%. The directivity of the antenna is (81.04°, 139.44°) at resonance frequency. The maximum gain of the antenna has been improved up to 3.11 dBi and the VSWR of the antenna is in between 1-2 in entire resonance frequency band. The simulation analysis of design patch antenna has been used by IE3D Software tool. The performance

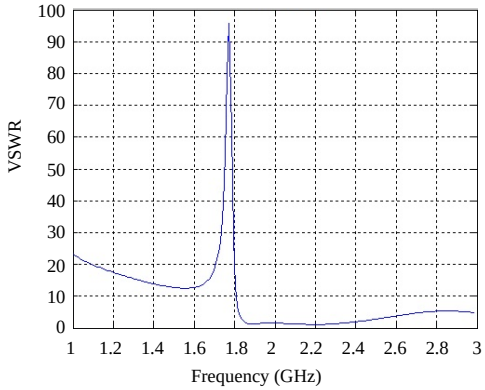

Fig. 4: VSWR of proposed antenna

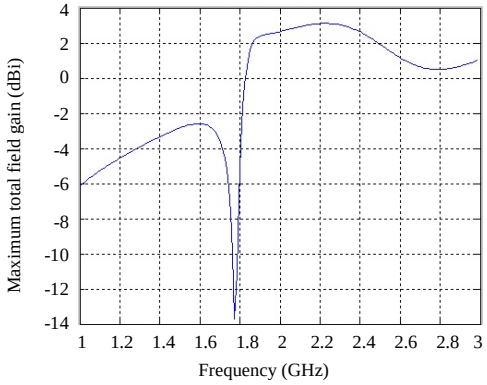

Fig. 5: Gain vs. frequency graph

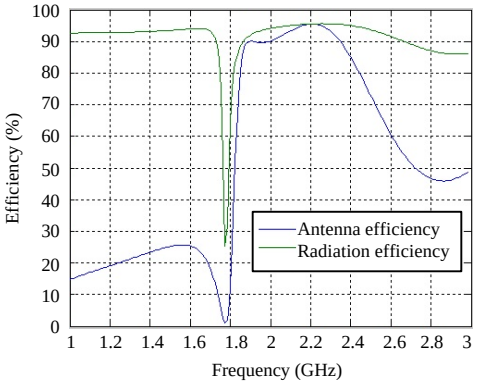

Fig. 6: Efficiency vs. frequency graph

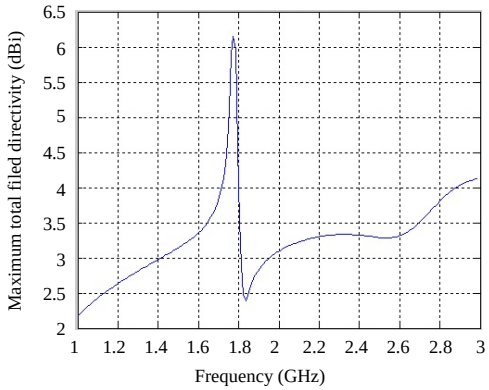

Fig. 7: Directivity vs. frequency graph

specifications of return loss, radiation pattern, VSWR, gain, antenna efficiency and directivity of proposed antenna is shown in Fig. 2-7.

CONCLUSION

The different characteristics of designed U slotted antenna has been studied. The fractional bandwidth of the designed antenna has been enhanced upto 25.80%. The resonance frequency of this antenna is 2.203 GHz with return loss of-34.91 dBi. At resonance frequency 2.203 GHz, the VSWR of designed antenna is 1.038 which is lie between 1 and 2. The maximum radiating efficiency and gain is about 95.61% and 3.11 dBi, respectively. This proposed antenna can be used in wireless communication system.

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