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Design of Wide Band Antenna using Pentagonal Slot

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ABSTRACT

Design of wideband antenna for wireless application using pentagonal slot is presented in this paper. This antenna was designed on FR substrate with permittivity of 4.3 loss tangent 0.02 and thickness of 1.6 mm. Proposed antenna occupied the bandwidth of 101.12 % from 1.9 GHz to 6 GHz. Current distribution and radiation pattern at different frequencies are also analyzed. Maximum simulated gain of antenna was 6.1 dBi.The antenna was simulated using CST.

Keywords-- Pentagonal slot, Bandwidth, Radiation pattern

I. INTRODUCTION

Microstrip antennas arewidely used in wireless communication because of its several merits like low profile, easy to fabricate, low cost, planar structure and easy integration with printed circuit board. But serious limitation is narrow bandwidth [1-2] S.C. Deshmukh, and R. P. Labade proposed hexagonal slot antenna for UWB applications. This antenna covered the bandwidth from 2.76 to 11.06GHz for S11 < -10 dB [3]. Jia-Yi Sze, and Kin-Lu Wong were presented wide-slot antenna fork-like tuning stub with 50- microstrip line. This antenna exhibited the bandwidth from 1.8 GHz to 2.9 GHz [4]. Yea Jan and Liang-Chin Wang reportedmicrostrip fed rhombus slot antenna with parasitic. They found parasitic element improves the bandwidth of the antenna. Proposed antenna covered the bandwidth of 108.7% and suitable for PCS, IMT-2000, and WiMAX applications [5]. Yong-Woong Jang designed wide slot antenna with circular patch fed by microstripline.The antenna occupied the bandwidth of 50.8% and suitable for DCS (1.71–1.88 GHz), GSM (0.86–0.88 GHz) PCS (1.85–1.99 GHz),cellular (0.824– 0.96 GHz) and IMT-2000 (1.90 –2.20 GHz) applications.The reported gain of antenna was 4.61 dBi [6]. In this paper pentagonal wide slot antenna is designed for wide band applications. Current distribution and radiation pattern are analyzed.

II. ANTENNA CONFIGURATION

The pictorial view of proposed topology is shown in figure 1. Proposed antenna is designed on FR-4 substrate. The properties of substrate are thickness 1.6 mm, loss tangent 0.02 and permittivity 4.4. Proposed antenna consists of elliptical notch, tapered microstrip line, pentagonal wide slot and two triangular slots. On top layer of the substrate, feed line elliptical notch, patch and two symmetrical triangular slots are designed. On ground plane, a pentagonal wide slot is created. This designed is energized by feed line. The parameter and their dimensions are given in table1.

Table:1 Dimension and parameter

Parameter	Dimension (mm)	Parameter	Dimension (mm)
P1	8	P2	14
P3	8	P4	4
G1	60	G2	60
G3	25	G4	
G5	29.68		

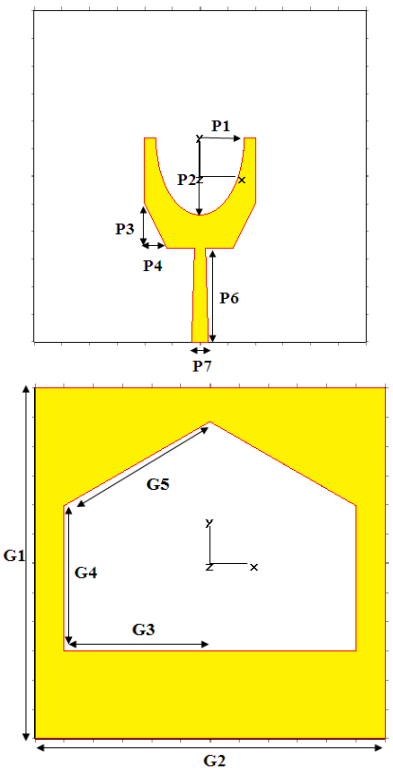


Fig.1. Configuration of proposed antenna

III. RESULT AND DISCUSSION

Performance of the antenna is shown in figure 2. This return loss characteristics shows antenna is resonating in three bands 1.3, 1.97 and 5.59 GHz. This antenna offers the bandwidth of 101.12 % from 1.9 GHz to 6 GHz. The lower cut off frequency is 1.26 GHz. Return loss at resonating frequencies 1.3, 1.97 and 5.59 GHz are -25.135 dB, -27.695 dB and -21.754 dB respectively. Maximum return loss is found at second resonating frequency. Figure 3 and 4 shows the variation of the input impedance of the antenna. In figure 3 real part of the input impedance varies near 50 ohm. Imaginary part of the impedance moves around 0 ohm as shown in figure 4.it also clear from figure input impedance is the function of frequency.

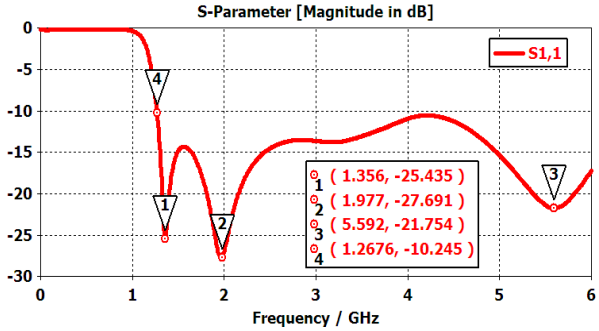


Fig.2. Return loss of proposed antenna

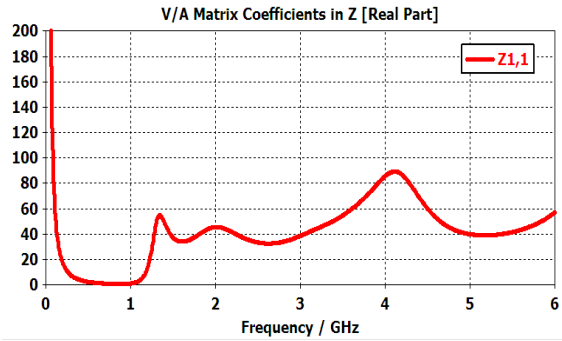


Fig.3. Real part of input impedance of proposed antenna

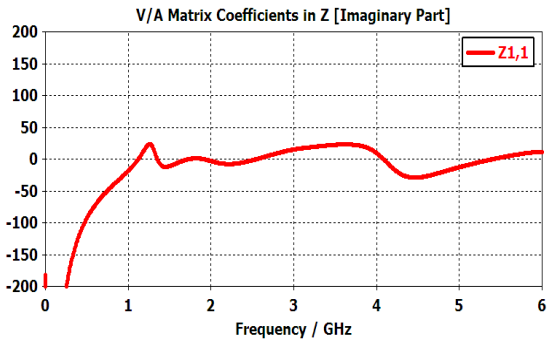
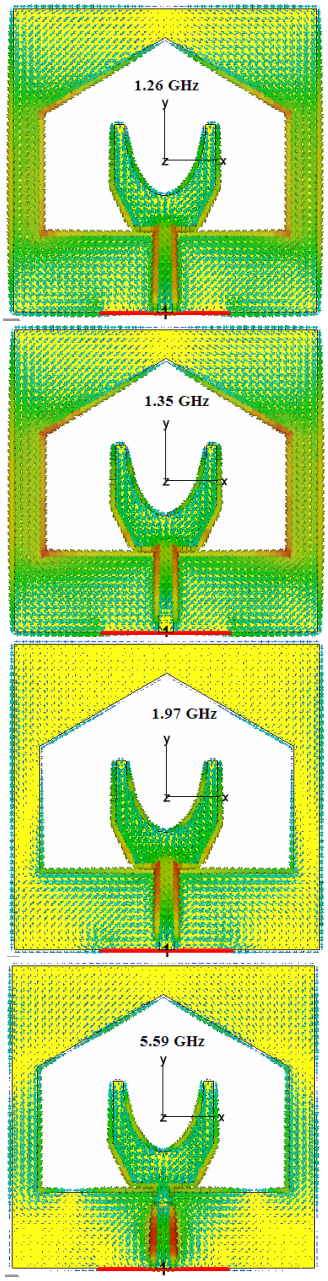


Fig.4. Imaginary part of input impedance of proposed antenna

Figure 5 illustrates the simulated current distribution. As shown in figure 5, current is distributed on ground plane, along the wide slot, along feed line, along the elliptical notch, along the perimeter of ground and along the perimeter of the patch. Such variation shows that antenna has higher order modes. At frequency 1.26 GHz and 1.35 GHz current is mainly distributed along the perimeter of ground and wide slot. Current vectors on patch and ground plane in opposite direction and current is stronger at the middle of wide slot on ground plane and at the Junction of patch and feed line. At same frequency, one half variation of current is found along the length of the ground plane, along the wide slot on ground plane and on radiating patch. At all frequencies current is symmetric about y axis. At frequency 1.97 GHz, concentration of the current is high on feed line and at junction of patch and feed line. At frequency 5.59 GHz current is mainly concentrated on feed line.



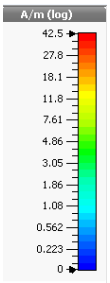
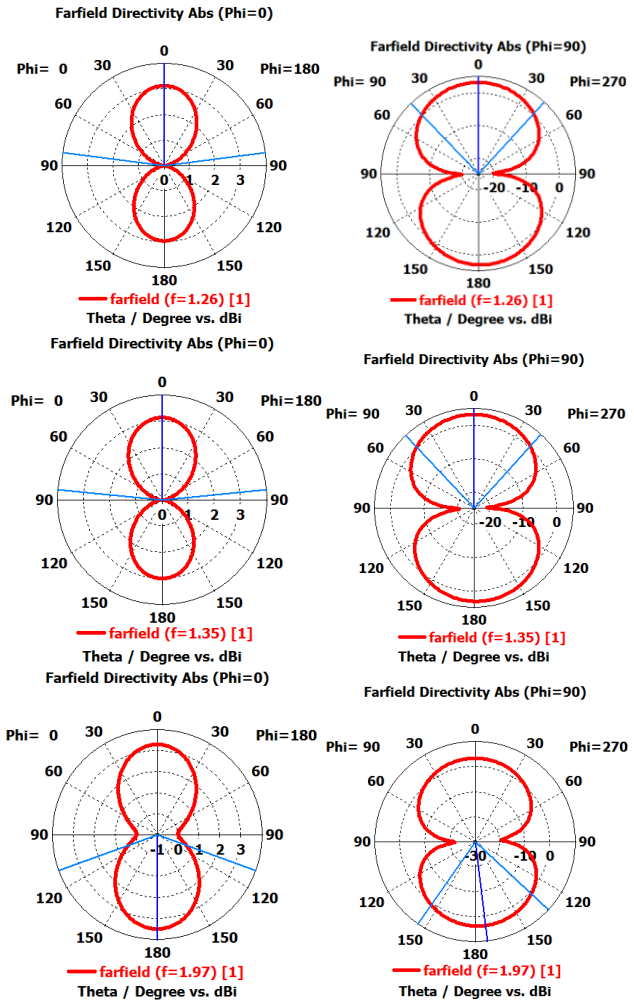


Fig 5. Current distribution of proposed antenna

Far field pattern of proposed antenna is shown in figure 6. At frequency 1.26 GHz and 1.35 GHz, shape of pattern is like 8 in E plane while omnidirectional pattern is found in H plane. At frequency 5.59 GHz quasi omnidirectional pattern is investigated in H plane. At frequency 1.97 and 5.59 GHz bidirectional pattern are found in E plane. Figure 7 shows the gain of the proposed antenna. it is found gain is linearly increased with frequency. Maximum gain of 6.5 dB is found at frequency 5.59 GHz.



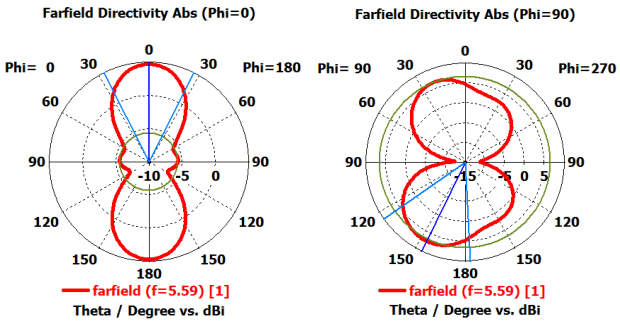


Fig 6. Radiation pattern of proposed antenna (E-plane left, H-plane right

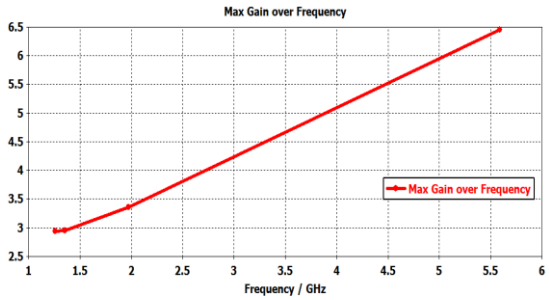


Fig.7. Gain of proposed antenna

IV. CONCLUSION

A pentagonal wide slot wide band antenna is proposed. This antenna offers the bandwidth of 101.12 % from 1.9 GHz to 6 GHz. Current distribution and radiation pattern are investigated. Return loss at resonating frequencies 1.3, 1.97 and 5.59 GHz arefound -25.135 dB, -27.695 dB and -21.754 dB respectively.

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