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Research Article

Design of a Band Notched Octagonal UWB Microstrip Antenna for Space Communication

Surajit Mukherjee1, Avisankar Roy2

1,2 (Dept. of Electronics and Communication Engineering, Haldia Institute of Technology, India)

ABSTRACT

A novel design of a single band notched octagonal shaped ultra-wide band (UWB) microstrip patch antenna has been presented in this manuscript. A modified inverted H shaped slot has been introduced on the radiator of the conventional octagonal monopole reference antenna. Due to this novel slot on the patch a band notch characteristics has been observed. The reference antenna radiates in the band 3.1GHz to 37.4GHz within VSWR<2. The modified proposed antenna produce the band 3.1GHz to 35.2GHz within VSWR<2 and a notched band in 6.7GHz to 8.8GHz with negative gain. The maximum realized gain for the proposed antenna has been found as 6.2dBi and total frequency band covers C band to K band. The reference and proposed antenna have been designed in commercially available software HFSS. With respect to the investigation the above said antenna may be suitable for long distance radio communication, space communication, automotive radar and astronomical observation purpose.

Keywords *(Band notched, Microstrip patch antenna, HFSS, Ultra Wide Band, Space Communication)*

I. INTRODUCTION

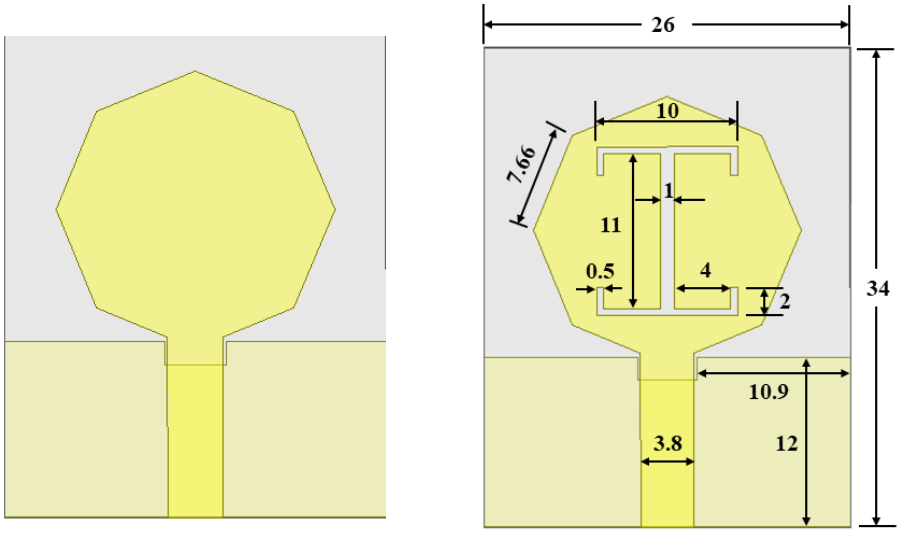
The investigation on designing of ultra-wide band antennas have been taken a rapid growth to accomplish the enormous demand in field of wireless communication as well as space communication. In this regard microstrip patch antennas play a very significant role because of its wondrous features like, very small size, portability, easy fabrication capabilities, conformability with any type of surfaces, low cost and low power consumption. So, now a days huge number of researchers have concentrated their work on design and modification of conventional microstrip patch antennas so that it can be used in modern communication and space communication devices. In addition with this, sometimes it is on the requirement to reject some unwanted frequency band to enhance the accuracy and efficiency of such devices embedded with the antennas. In this point of view the band rejection or band notch characteristics of the UWB antennas are also in the field of new research and investigation recently.

Several articles have presented different types of design of UWB microstrip patch antennas with band notch characteristics. Radiation characteristics over the UWB frequency range has been achieved by using different shapes of radiators like rectangular, circular, hexagonal, square, fractal etc. which are presented in some literature [1-9]. The articles [1-4] show some design of UWB antennas using the slots on the patch, which is very common method. Other methods like cutting slots in the ground plane [5 - 7], introducing parasitic elements in the ground plane [8 - 10] can also be used to obtain the ultra-wide band application with band notch effect.

In this article an octagonal radiator has been taken as reference antenna on which an inverted H shaped slot has been cut to get the band notch effect over the ultra-wide band application. The designed proposed antenna shoes a huge bandwidth of 32.1 GHz in the frequency range of 3.1GHz to 35.2 GHz under VSWR<2. A notched band has been observed in the band of 6.7GHz to 8.8GHz. The maximum realized peak gain has been obtained as 6.2dBi.

II. DESIGN CONCEPT OF ANTENNA

An octagonal monopole antenna with microstrip line feed has been taken as the reference antenna. An inverted H shaped slot with optimum dimension has been introduced on the radiator to achieve the desired result. The designed antenna structure is shown in Fig. 1. The design parameters are depicted in the figure.



(a) (b)

Fig. 1 – (a) Reference Antenna, (b) Design prototype of the proposed antenna with slot and dimension

The proposed antenna has been designed on Arlon AD300A substrate having thickness as 1.524 mm and relative permittivity as 3. All the dimensions have taken as optimum values from parametric studies. The total dimension of antenna is only $34 \times 26\ mm^2$. The antenna structure has been simulated in commercially available software HFSS.

III. RESULTS AND DISCUSSION

As per the simulation by HFSS, it has been found that the reference antenna originates the frequency range of 3.1GHz to 37.4GHz under VSWR<1 and the slotted proposed antenna produces the frequency range over 3.1GHz to 35.2GHz with a notched band in the range of 6.7GHz to 8.8GHz. The maximum realized peak gain of the proposed antenna has been found as 6.2dBi. The frequency vs S11 graph of the reference and proposed antennas are depicted in Fig. 2.

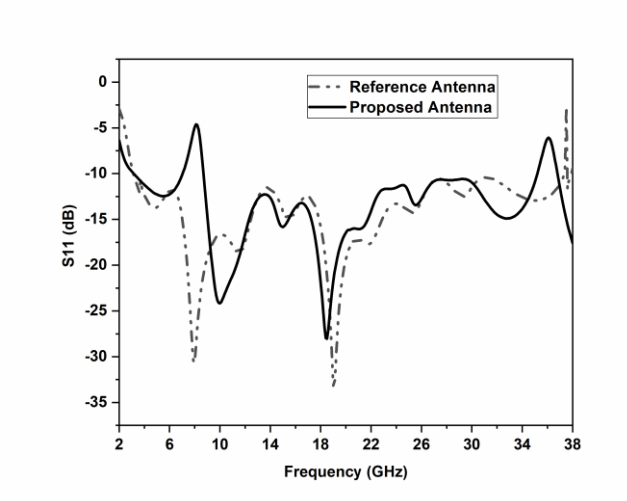


Fig. 2 – Frequency vs S11 graph of the reference and proposed antennas

The frequency vs realized peak gain graph of the designed antenna is shown in Fig. 3 and the simulated co-pol and cross-pol radiation patterns of the proposed antenna at 6GHz, 10GHz and 18.5GHz are presented in Fig. 4-6 respectively.

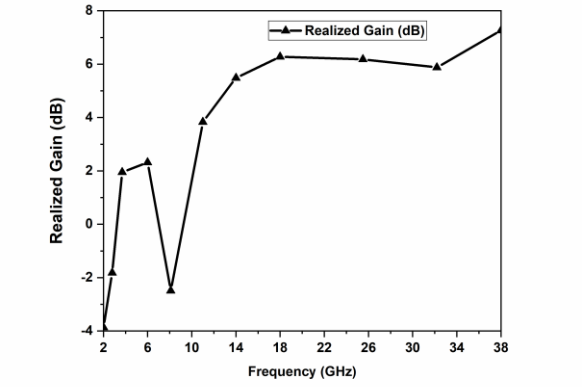


Fig. 3 – Frequency vs gain graph of the reference and proposed antennas

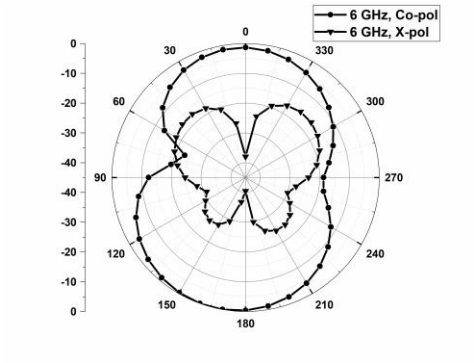


Fig. 4 – Radiation pattern of proposed antenna at 6GHz

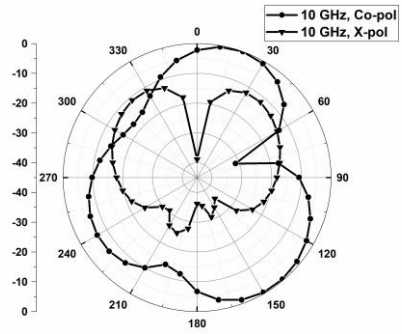


Fig. 5 – Radiation pattern of proposed antenna at 10GHz

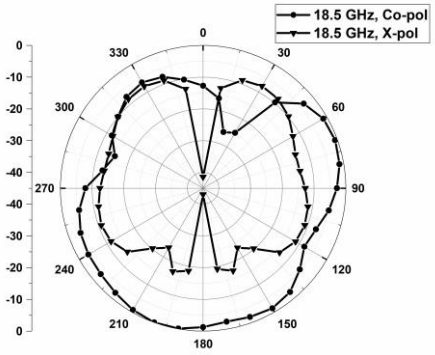


Fig. 6 – Radiation pattern of proposed antenna at 18.5GHz

IV. CONCLUSION

In this article a novel design of a single band notched octagonal shaped ultra-wide band (UWB) microstrip patch antenna has been presented. A modified inverted H shaped slot has been introduced on the radiator of the conventional octagonal monopole reference antenna. Due to this novel slot on the patch a band notch characteristics has been observed. The reference antenna radiates in the band 3.1GHz to 37.4GHz within VSWR<2. The modified proposed antenna produce the band 3.1GHz to 35.2GHz within VSWR<2 and a notched band in 6.7GHz to 8.8GHz with negative gain. The maximum realized gain for the proposed antenna has been found as 6.2dBi and total frequency band covers C band to K band. With respect to the investigation the above said proposed antenna may be suitable for long distance radio communication, space communication, automotive radar and astronomical observation purpose.

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