TRANSACTIONS ON ELECTROMAGNETIC SPECTRUM

Crescent-Shaped Monopole Antenna for WLAN Band

Ahmet Yasir TEKSAR[1*]
[1]Department of Electrical and Electronics, Engineering, Faculty of Technology, Gazi University, Ankara, Turkey
Email: ayteksar@gmail.com, ORCID: 0000-0001-9198-0160

*** Corresponding author e-mail address:** ayteksar@gmail.com

Received: 20 October 2021
Revised: 25 November 2021
Accepted: 10 December 2021

Research Article
Vol.1 / No.1 / 2022
Doi: 10.5281/zenodo.6643727

Abstract: In this paper, design and optimization of the crescent-shaped monopole antenna which is operates on 5 - 6 GHz WLAN band is proposed. In the antenna design, FR4 epoxy material is used. The antenna is optimized using HFSS program. For the optimization of the designed antenna, some values can be changed such as size of the ground plane, width of substrate, radius of circle, and size of the feeding line. The obtained results show that, there is a need for multiple parameters to optimize the antenna for getting good results. In addition to this, the designed model can be used in WLAN band.

Keywords: Crescent-shaped monopole antenna, WLAN band, HFSS antenna design

Cite this paper as: Teksar, A., Crescent-Shaped Monopole Antenna for WLAN Band. *Transactions On Electromagnetic Spectrum* 2022; 1(1): 1-4, Doi: 10.5281/zenodo.6643727

1. INTRODUCTION

An antenna is a device designed to convert transmitting or receiving electromagnetic waves. Microstrip antennas have many advantages and are frequently used in practice. Microstrip antenna in Fig. 1, consist of ground plane, dielectric substrate, feedline and patch. Microstrip antennas are used in satellite communication, GPS, RFID and radar applications.

Microstrip antennas have many features such as low production cost, small size and being commercial. Microstrip antennas have low power handling capacity, low gain, and narrow bandwidth. These features may seem like disadvantages, but in some places, these features become advantages. Microstrip antennas are formed by placing dielectric material on the ground and conductive paths on this material. Conductive paths can be any shape: triangle, star, rectangle etc.

With the High Frequency Structure Simulator (HFSS) software program, a simulation program of a microstrip antenna can be made by using the finite element method (Finite Element Method, FEM). As a result of the physical changes made on the antenna, examinations are made on return loss, bandwidth, directivity, HPBW, gain and radiation efficiency.

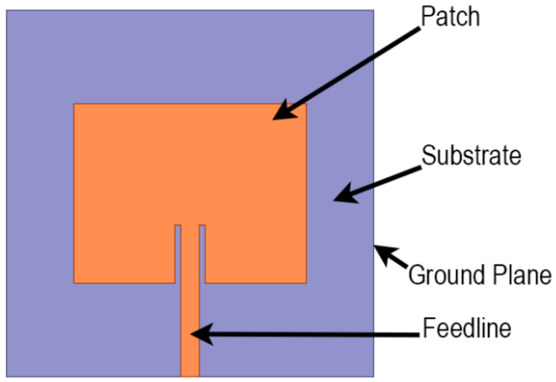


Figure 1. Microstrip Patch Antenna.

2. LITERATURE SURVEY

According to literature, concept designs of microstrip antennas were studied by Deschamps in 1953. Byron introduced the conducting strip radiator in 1970. Lo and Carver helped to solve the microstrip antennas theoretically by performing numerical analysis. In 2014, Nayna made 10 GHz operation of square and circular patch antennas in the X-band range. Today, extensive studies are carried out on antennas. Since it has narrow bandwidth, it is not preferred in wireless communication applications. As a result, antenna gain, return loss, directivity and bandwidth can be changed by changing the geometry of the microstrip antenna [1].

There is different survey in the literature. For instance, a novel study made by Marzapour and Hassani increased the bandwidth of the star shaped patch antenna which one has a small dimensions and have an important place in practical applications. Many techniques have been developed in the study for bandwidth increasing and size reduction such as slot-loading, feed modification, chip loading, meandered ground plane. In addition to these techniques, bandwidth can be increased by using air substrates [2].

In another paper, triangle patch antenna design has been realized for multi-band applications. In the paper, authors change the dielectric coefficient of the dielectric material which makes up the microstrip antenna. As a result of the increase of the dielectric coefficient (ϵ_r) of the material, the bandwidth decreases. When the return loss versus frequency graph of the antenna analyzed with the HFSS program, 3 different frequencies have occurred at lesser than -10 dB. These are 5.8 GHz, 6.4 GHz and 7.3 GHz [3].

In another paper, theoretically, microstrip patch antennas are presented. The comparison of conventional antennas and microstrip patch antennas is discussed. As a result of the discussion, microstrip antennas are used due to feedline flexibility, circular polarization properties, ease of conformity and fabrication. Special antenna design can be made for the special applications [4].

In another work, the crescent-shaped microstrip antenna (3-10 GHz) is designed for ultra-wide bandwidth (UWB) applications. A crescent-shaped microstrip antenna can be used when it is desired to work in this band range. The radiation characteristics of the crescent-shaped microstrip antenna were compared with the elliptical antenna. Antenna shapes and impedance measurements gave good results for the crescent-shaped microstrip antenna. The radiation patterns were consistent. A crescent-shaped patch antenna was made by removing a circular part inside the elliptical antenna while giving the crescent shape. Antenna performance changes according to the radius ratios of elliptical and circular shapes [5].

In this paper, the crescent-shaped monopole antenna is presented which one works on the 5- 5.5 GHz WLAN band. The designed antenna has a size of 20 x 20 x 1.6 mm. The antenna has bandwidth of 500 MHz and gain of 3.5 dBi.

3. THE DESIGNED ANTENNA

The antenna was designed as a monopole and given in Fig. 2 and Fig. 3 that is a crescent-shaped antenna. The structural features of the antenna are given in Table 1. By changing the values in Table 1, the necessary parameters to optimize the antenna can be examined. The reflection coefficient/frequency graph of the antenna was examined and given in Fig. 4.

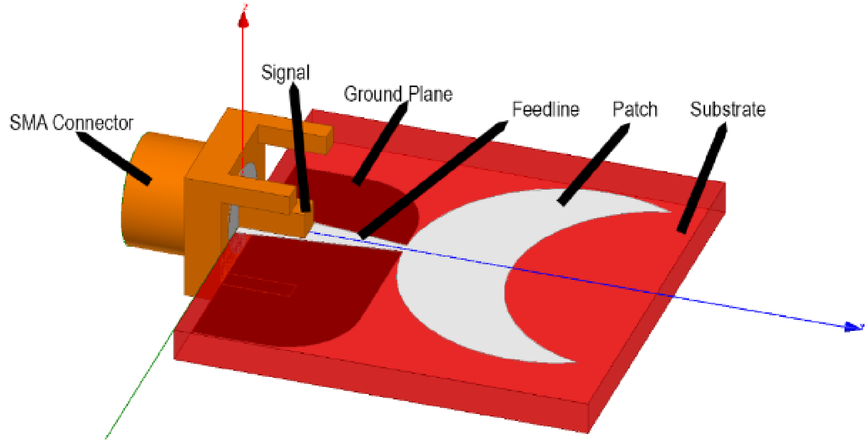


Figure 2. Crescent-shaped Monopole Antenna.

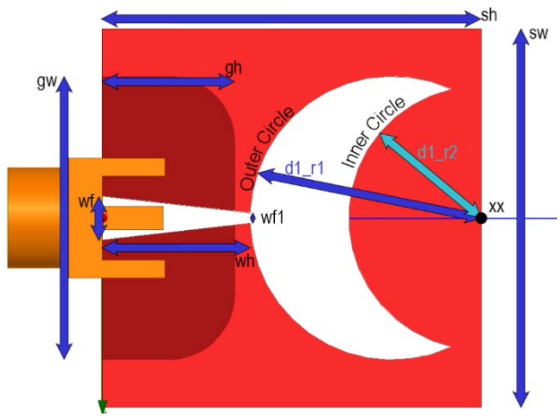


Figure 3. Specifies of antenna.

Table 1. Specifies of Patch Antenna

Parameter	Value
h (Thickness of Substrate)	1.6 mm
wf (Width of Feedline, that is near to SMA)	3 mm
sw (Width of Substrate)	20 mm
sh (Height of Substrate)	20 mm
wh (Length of Feedline)	8 mm
d1_r1 (Radius of Outer Circle)	7.5 mm
d1_r2 (Radius of Inner Circle)	7 mm
wf1 (Width of Feedline, near to patch)	0.516 mm
gh (Height of Ground Plane)	7 mm
gw (Width of Ground Plane)	15 mm
xx (Center of Inner Circle)	5 mm

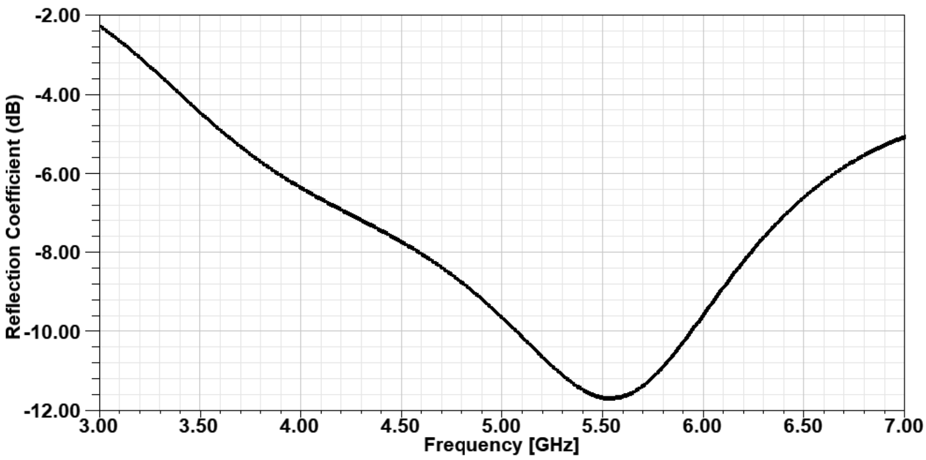
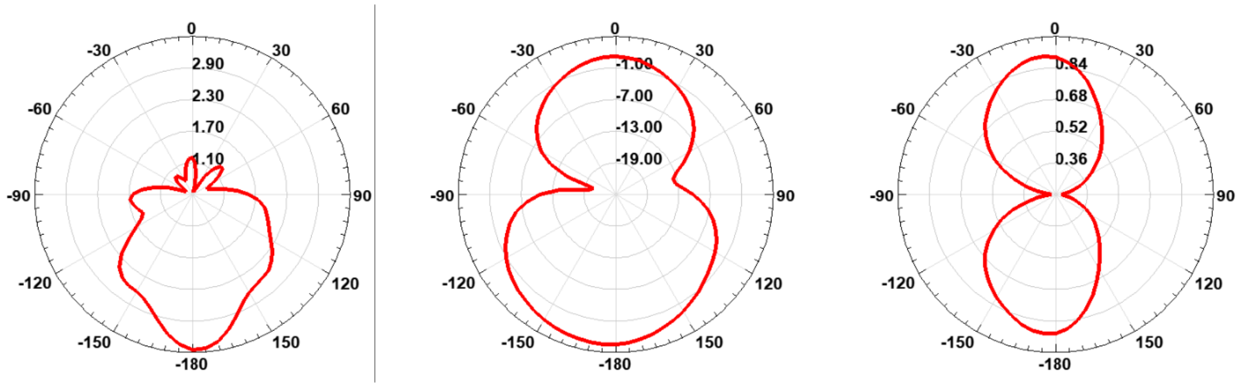


Figure 4. The reflection coefficient of the proposed antenna for the values in Table 1.

According to the reflection coefficient graph of the antenna, it has a bandwidth of 1000 MHz which starts from 5 GHz and ends 6 GHz. The radiation patterns of the antenna at the 5.5 GHz band is given in the Fig. 5. The antenna has a maximum gain of 3.5 dBi at the 5.5 GHz band.



a) Phi=0 *b) Phi=90* *c) Theta = 90*

Figure 5. The radiation patterns of the proposed antenna.

4. CONCLUSION

In this paper, the design and analyses of the Crescent-shaped monopole antenna is presented. For the operation of the antenna some values are important. These are width of substrate, size of the circle. To optimize the antenna, it is necessary to play with more than one values. To increase the operating frequency of the antenna from high frequencies to low frequencies, the size of the antenna should be changed.

REFERENCES

[1] Patil, R., & Popalghat, S. K. A review of various types of patch antenna. *International Journal on Recent and Innovation Trends in Computing and Communication*, 2016:4(4), 653-655.

[2] Marzapour, M., & Hassani, H. R. Wideband star shaped microstrip patch antenna. *Electronics Letters*, 2008: 42(23).

[3] Narayana, B. L., & Bhavanam, S. N. Design & Simulation of Triple Frequency Triangular Patch Antenna by Using HFSS 14.0. *International Journal of Applied Engineering Research*, 2015:10(20), 2015.

[4] Singh, I., & Tripathi, V. S. Micro strip patch antenna and its applications: a survey. *Int. J. Comp. Tech. Appl*, 2011:2(5), 1595-1599.

[5] Azenui, N. C., & Yang, H. Y. D. A printed crescent patch antenna for ultra wideband applications. *IEEE Antennas and Wireless Propagation Letters*, 2007:6, 113-116.