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Design of Textile Microstrip Patch Antenna for Aeronautical &X-Band Applications

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Abstract: This paper presents the design and simulation of a square Microstrip patch antenna for aeronautical radio navigation applications. The square shaped patch is used because of easily confirmable shape. The antenna is to be designed to operate in the X-band region. The inset Microstrip line feed is used because it is easy to fabricate. To design the proposed antenna Rogers RT Duroid 5880 substrate is used with dielectric constant of 2.2.The dimensions of the antenna are 10X10X0.8mm^3. The antenna dimensions were calculated using TEM model and simulated using CSTMWS -2014.The designed antenna is obtaining minimum reflection coefficient of -28.966 dB, bandwidth of 300 MHz and gain of 4.9 dBi. The other parameters like VSWR and directivity are analyzed to judge the performance of the proposed antenna.

Key words: Microstrip patch antenna,X-band, VSWR, directivity and CSTMWS.

Introduction

Antenna is a transducer which is designed to transmit or receive electromagnetic waves(1-2).The usage of the Microstrip antennas is spreading widely in all the fields and areas and now they are booming in the commercial aspects due to their low cost of the substrate material and the fabrication. Microstrip antennas have several advantages over conventional microwave antenna and therefore are widely used in many practical applications. The Microstrip patch antennas are well known for their performance and their robust design, fabrication and their extent usage(3). The Microstrip antennas are designed to operate at different frequencies (4-6) like WLAN& Wi-Max(7), Bluetooth(8), Wi-Fi(9), WPAN (10) and X-band applications. From the literature survey, many Microstrip antennas are designed to operate at X-band frequencies. As fabrication point of view they are having complex structures. In this paper we propose a Microstrip antenna which can operate at X-band frequencies with simple structure.

In this paper, a square shaped patch antenna designed to resonate at 9.6GHz for aeronautical radio navigation applications is proposed. The substrate Rogers RT Duroid 5880 with a dielectric constant ε_r = 2.2 and a thickness of 0.8 mm is used as the patch. The proposed antenna has overall dimensionsof 16mm*16mm*0.8mm. The antenna having an input characteristic impedance of 50 Ω is excited using lumped port.

Design

The proposed patch antenna operating at 9.6 GHz for aeronautical radio navigation is shown in figure 1. The width Wand length L of the patch element as shown in Figure1 are analytically calculated using equation (1) and (2).

$$W = \frac{c_0}{2 f_r}\sqrt{\frac{2}{\varepsilon_r + 1}} \qquad (1)$$

Where $c_o$is the velocity of light, $f_r$is the frequency of operation and ε_r is the dielectric constant of the substrate.

$$L = L_{eff} - 2\Delta L \qquad (2)$$

Where $L_{eff} = \frac{c_0}{2 f_r \sqrt{\varepsilon_{reff}}}$ (3)

and the effective parameters are given by the equations (4) and (5)

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{W}\right]^{-\frac{1}{2}}, \frac{W}{h} > 1 \qquad (4)$$

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$$\Delta L = 0.412h\frac{\left(\varepsilon_{reff}+0.3\right)\left(\frac{W}{h}+0.264\right)}{\left(\varepsilon_{reff}-0.258\right)\left(\frac{W}{h}+0.8\right)} \quad (5)$$

The proposed antenna was connected to the Microstrip line of 50 Ω having a width of W_2= 1 mm. The dimensions of the antenna are tabulated below in Table 1.

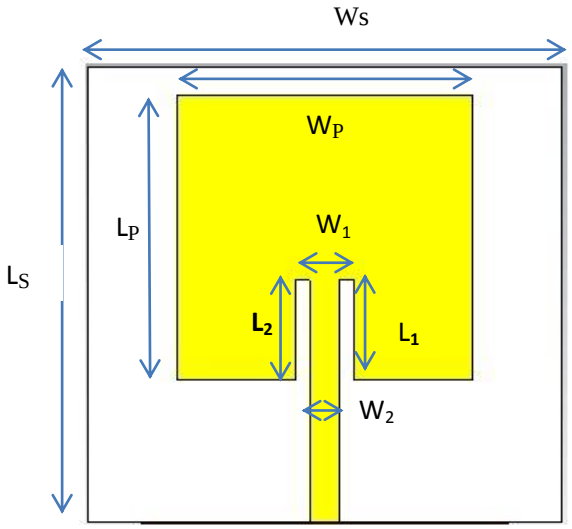

Figure 1: Proposed Microstrip Patch Antenna

Table1: Dimensions of proposed antenna

Parameter	Value (mm)
Width of the Substrate(W_S)	16
Length of the Substrate (L_S)	16
Width of thepatch (W_P)	10
Length of the Patch (L_P)	10
W_1	2
L_1	3.5
W_2	1
L_2	8.5

To design the proposed single patch elementthe simulation software CST MWS-14 (Computer Simulation Tool) was used. The antenna consists of 3 layers, the first layer at the bottom is the ground plane made of copper, the second layer is the Rogers RT Duroid 5880 substrate with a loss tangent (tan δ) of 0.0009, a thickness of 0.8 mm and the top layer is the radiating patch which is the copper cladding of 0.1mm. The next section discusses various simulation results of the proposed antenna design.

Results and Discussion

The antenna was modeled and simulated using CSTand each layer of the proposed design was assigned with its respective physical and electrical properties. The result of the Return loss, VSWR (Voltage Standing Wave Ratio), the radiation pattern and 3D- Radiation pattern of the square single patch element obtained are shown. The S_{11}parameters were obtained using the lumped-port configuration. The single patch resonates at 9.6 GHz with a Return loss of -28.966 dBi shown in Figure 2.

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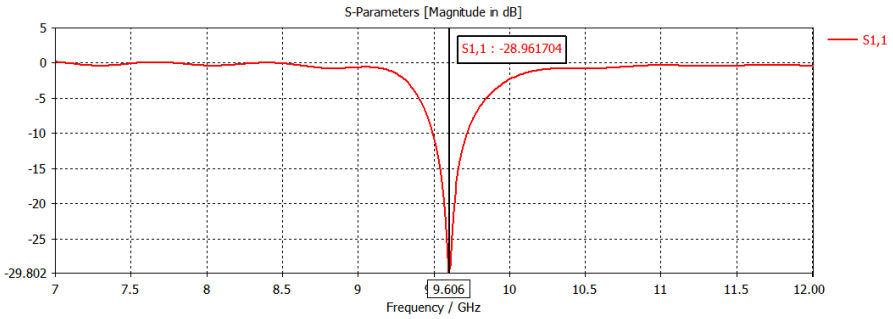

Figure 2: Return Loss plot

The acceptable level of VSWR for wireless application should be less than 2 is shown in Figure 3, the VSWR of the single patch antenna is 1.07.

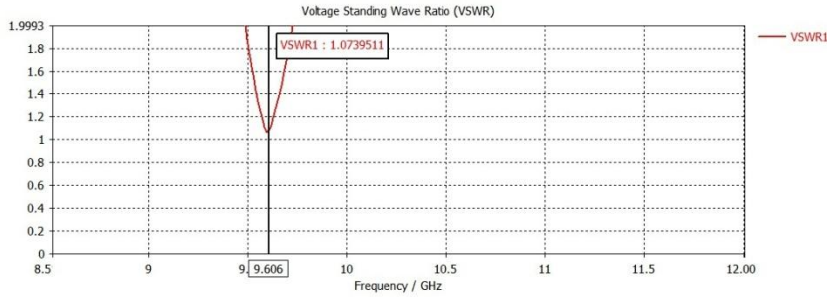

Figure 3: VSWR plot

The antenna achieved directivity of 6.79 dBi and a high gain of 4.9 dB which is considered excellent in terms of a compact microstrip patch antenna. The 2D-Radiation pattern is shown in figure 4.

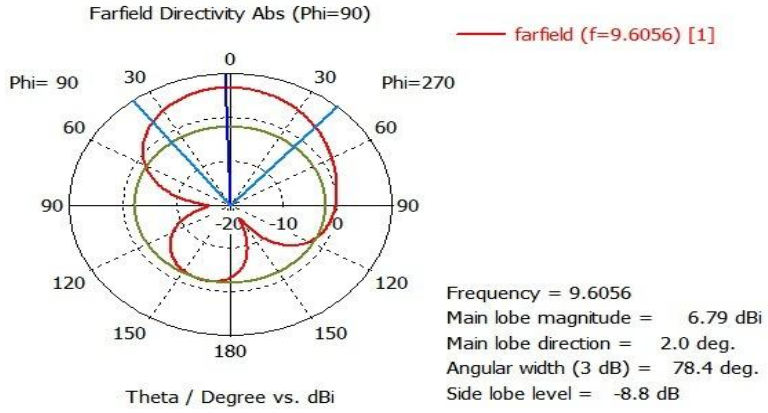

Figure 4: 2D-Radiation Pattern Plot

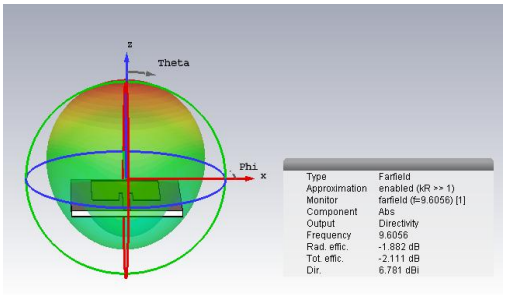

Figure 5: 3D- Radiation Pattern Plot

The 3D- Radiation pattern at φ=90° is presented in Figure 5. The maximum far-field radiation of the designed antenna is 6.71 dBi.

The summary of result is shown in Table 2 below. The obtained parameters show that the proposed antenna is suitable for aeronautical radio navigation communication.

Table 2: Summary of Results

Antenna Parameters	**S_{11} Parameter**	**VSWR**	**Gain**	**Directivity**	**Band Width**
Specifications	-28.966 dB	1.07	4.9dB	6.79dBi	300MHz

Conclusion

The simple Textile square shapedMicrostrip patch antenna is designed for Aeronautical Radio navigation and X-Band frequency applications. The designed antenna resonates at 9.6 GHz with a return loss of -28.966 dBi. The gain of the designed antenna is 4.9 dBi and the radiation pattern is directional. The integration of the antenna can be done in devices where space is a major concern. The antenna can be used in future aeronautical radio navigation devices. The VSWR of the antenna at the center frequency 9.6GHz is close to 1 i.e 1.0731. The antenna is designed on textile material so it can be used as wearable Microstrip antenna.

References

[1]. C.A.Balanis,"Antenna Theory: Analysis and Design “, Third edition John Wiley & Sons, Inc., 2005.
[2]. John D Kraus, Ronald J Marhefka, Ahmad S Khan, “Antennas For Applications”, Third edition, TMH Publications
[3]. Girish Kumar, K.P. Ray, “Broadband Microstrip Antennas”2003 ARTECH HOUSE, INC.685 Canton Street Norwood, MA 02062.
[4]. Kiruthika V, Dr. V.Thulasi Bai”Design of 5G Multiband Antenna”,International Journal of Scientific Research inComputer Science, Engineering and Information Technology © 2017 IJSRCSEIT | Volume 2 | Issue 2 | ISSN: 24563.
[5]. DheerajMungur, ShankarDuraikannan “Microstrip Patch Antenna at 28 GHz for 5G Applications” Journal of Science Technology Engineering and Management-Advanced Research & Innovation Vol. 1, Issue 1, January 2018.
[6]. RibhuAbhusana Panda, Upasana Patnaik, Nibedita Bisoyi, Kiran Tripathy,”Microstrip Patch Antenna Design at 5.2GHz”, ISSN © 2017 IJESC Volume 7 Issue No.4.
[7]. Nagabhushana H. M. Dr.C.R. Byrareddy” Slotted and Miniaturized Patch Antenna for WLAN and WiMAX Applications”International Journal of Advanced Information Science and Technology (IJAIST) ISSN: 2319:2682 Vol.6, No.4, April 2017.
[8]. Ratish Barman, SandipanSinha, Shankha Roy, Avishek Das “Design of inset feed Microstrip patch antenna for BluetoothApplication”International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 04 Issue: 03 Mar -2017.
[9]. K.Dinakaran, M.Vajikabanu, M.Priyadarshani,wari“ Design of Microstrip Patch Antenna For Wi-Fi Applications”International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE) Volume 5, Issue 1,January 2016.
[10]. HashibulAlam“Design Rectangular Microstrip Patch Antenna for IEEE 802.15.3a (WPAN) with MB-OFDM Ultra WideBand Communication System” International Journal of Scientific and Research Publications, Volume 4, Issue 2, February2014 1 ISSN 2250-3153.