Design of Rectangular Microstrip Patch Antenna with Microstrip Line Feed

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Abstract – *The proposed Rectangular Microstrip Patch Antenna (RMPA) is designed on low cost RT/duroid 5880 substrate and it is fed by 50 Ω microstrip line. The proposed antenna is designed at a height of 1.588 mm from the ground plane. This design is operated at 10 GHz. High Frequency Structure Simulator (HFSS) is used to design the RMPA.*

.**Keywords**— Rectangular Micro strip Patch Antenna, Return loss, VSWR.

Introduction:

Wireless communication devices are omnipresent nowadays and their use is gradually on the rise. These devices include AM and FM radios, cellular mobile phones, tablets, laptops, Global Position System (GPS) devices, Radio Frequency Identification (RFID) system etc. The antenna, being an integral part of these devices, plays an important role in defining the performance of these devices. Therefore the design of an antenna for any wireless device should be carried out with care in order to guarantee good system-level performance. Among the various kinds of antennas, Mirostrip Patch Antennas (MSA) have received considerable attention during the past decades because of their low-profile nature and their ease of integration with associated electronics, which make them very suitable for use in compact wireless devices [1]. But MSA have some disadvantages also like narrow bandwidth, low gain, low power handling capability and high Q etc [2].

MSA in its simplest form consists of a radiating patch on one side of a dielectric substrate and a ground plane on the other side. The radiating patch may be square, rectangular, thin strip, circular, elliptical, triangular or any other configuration [3]. Fig.1describes a micro strip line which has a metal strip of length L, width W, d is the thickness and ε_r is the relative permittivity of the substrate [4].

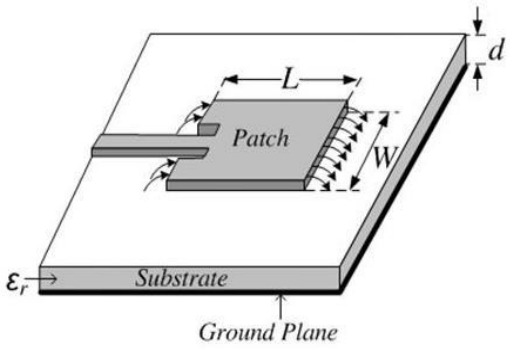

Fig. 1. Microstrip Line

In this paper we have presented microstrip patch antenna which operates in the frequency range of 8 GHz to 12 GHz which is mainly designed to operate in wireless communication. The simulation results were obtained by using HFSS.

Antenna Design

Fig.2. shows the geometry of the proposed antenna. It consists of a single patch on top and one layer of dielectric. In this proposed antenna design we have used RT/duroid 5880 as the substrate material with dielectric constant value of 2.2 and dielectric loss tangent of 0.0009

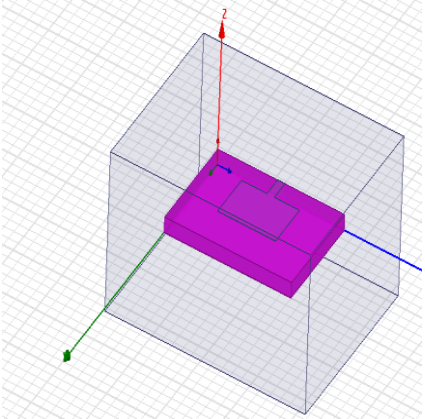

Fig.2 Design of Rectangular microstrip patch antenna

The width (W) and length (L) of reference antenna are calculated from conventional equations discussed in literature survey [5, 6].

For an efficient radiator, a practical width that leads to good radiation efficiencies is

$$W = \frac{V_0}{2f_r}\sqrt{\frac{2}{\varepsilon_r + 1}}$$

Where Vo is the velocity of light

ε_r is the dielectric constant of the substance

The actual length of the patch can be calculated by using

$$L = \frac{1}{2f_r\sqrt{\varepsilon_{reff}}\sqrt{\mu_o\ \varepsilon_o}} - 2\Delta L$$

Where

$$\varepsilon_{reff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left(1 + 12\frac{h}{W}\right)^{-1/2}$$

Actual length of the patch

$L = L_{eff} - 2\Delta L$

Calculation of length extension

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

Table 1.Parameters of Rectangular Microstrip Patch Antenna

Parameter	Value	Unit
Dielectric constant	2.2	-
Loss tangent	0.0009	-
Thickness	1.588	mm
Operating frequency	9.85	GHz
Length L	9.06	mm
Width W	11.86	Mm
Cut width	1.5	mm

Simulation Results

a) Return loss Vs frequency

Return loss of RMPA has been simulated using HFSS as shown in Fig.3. The return loss for the proposed designed antenna is -40 dB which is sufficient for the wireless communication as compared to other antennas.

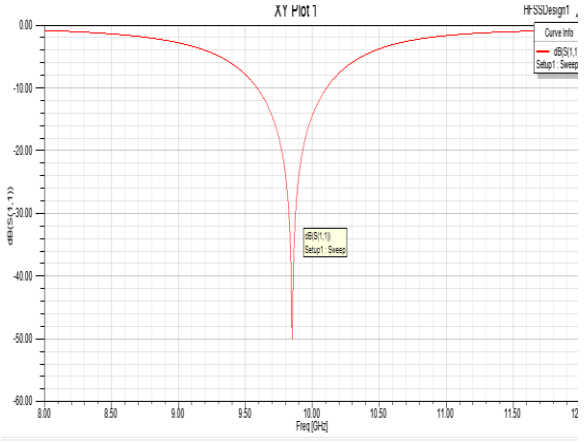

Fig.3. Return loss Vs Frequency

b) VSWR Vs Frequency

The VSWR for the proposed antenna is obtained as 1.5 as shown in Fig. 4 which is very good for impedance matching.

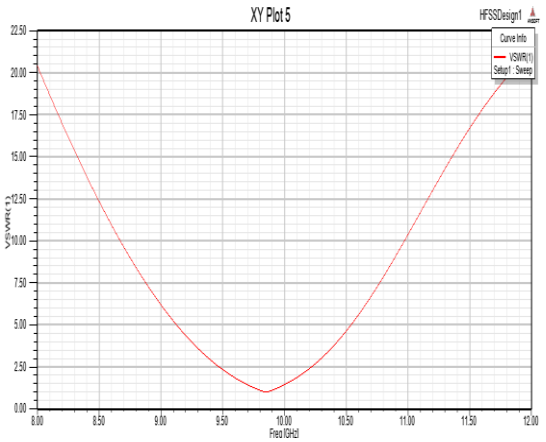

Fig.4. VSWR Vs Frequency

Conclusion

This paper presents the design of Rectangular microstrip patch antenna with a cut off frequency of 9.8 GHz. The proposed antenna have been achieved the value of VSWR of 1.5 and return loss of -40 dB.

References

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