Volume : 3 | Issue : 5 | May 2014 • ISSN No 2277 - 8179

Research Paper

Design of 1×2 Series-Fed Microstrip Patch Antenna Array For Wireless LAN

Engineering

KEYWORDS : microstrip feed, microstrip patch antenna, rectangular patch, array

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ABSTRACT

In the recent days, 5GHz WLAN technology is a rapidly emerging and is becoming popular over the existing 2.4GHz technology. In this paper, we present the design of series-fed microstrip patch antenna array for 5GHz WLAN application. The proposed antenna utilizes two rectangular patch element fed with microstrip feed line to achieve higher gain and highly directional beam. The antenna is designed and simulated on CST Microwave Studio Software.
This antenna based on Microstrip-feed configuration has the maximum bandwidth obtained about 196Mhz.

INTRODUCTION

There is a rapid-growth in various wireless communication system & wireless services such as wireless application, WLAN(Wireless Local Area Network). Generally, WLAN used are operated at different frequency such as at 2.4Ghz, 5GHz, etc. But the 5GHz frequency is better than 2.4GHz because 2.4GHz frequency band has become overcrowded and suffer high interference from the devices like as microwave oven, cordless planes, blue-tooth devices, baby monitors, etc and so, overall signal to noise ratio (SNR) is degraded.

5GHz band is pretty cleaner and has several advantages like as: It has large number of non-overlapping channel i.e. less ratio congestion. It has also better penetration and scattering capability.

As we know that, in application of wireless communication it requires small size, low profile, low cost fabrication & ease of installation and integration constraints and these constraints are fulfilled by microstrip patch antenna. So, in this paper the design of microstrip patch antenna is reported with an operating frequency of(5.4GHz).

DESIGN

Microstrip Antenna has radiating patch at one side and ground plane at other side is separated by dielectric substrate. Microstrip antennas are used for low profile & low-cost fabrication. There are 3 parameters i.e. resonant frequency, dielectric constant of substrate & height of substrate which are essential for the designing of microstrip patch antenna. The length & width of the patch can be calculated using following equations:

$$W = \frac{1}{2f_r\sqrt{\mu_0 \varepsilon_0}} \times \sqrt{\frac{2}{\varepsilon_r + 1}}$$

$$L = \frac{1}{2fr\sqrt{\varepsilon_{eff}}\sqrt{\mu_0 \varepsilon_0}} - 2\Delta L$$

Where,

$$\Delta L = 0.41h \frac{\varepsilon_{eff} + 0.3}{\varepsilon_{eff} - 0.258} \times \frac{\left(\frac{w}{h} + 0.264\right)}{\left(\frac{w}{h} + 0.8\right)}$$

$$\varepsilon_{eff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2\sqrt{1 + \frac{h}{w}}}$$

Where,

Here,

λ is the wavelength.

fr is the resonant frequency.

L and W are length & width respectively.

?r is the dielectric constant.

The microstrip antenna which has been proposed in this paper is designed at 5.4GHz frequency & is fabricated using RT Duroid 5880 dielectric substrate having dielectric constant 2.2 & loss tangent of 0.009. The dimension has been calculated using above equations are given as follows:-

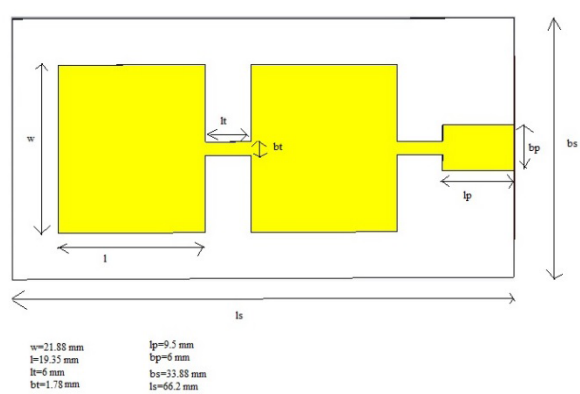

Fig 1: Dimension of Antenna

Here, series feed technique has been used which usually consists of a continuous transmission line in which small proportion of energy are coupled with the individual element. It gives us ease of fabrication and the designing is simple.

Simulation Results

CST microwave studio software was used to design and simulate this antenna. The different parameters such as:- return loss, VSWR, bandwidth and radiation pattern along with directivity, gain and antenna efficient ,etc. were calculated to analyze the performance of the antenna using this software.

At first return loss was measured to ensure that antenna exactly

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operate at resonant frequencies.

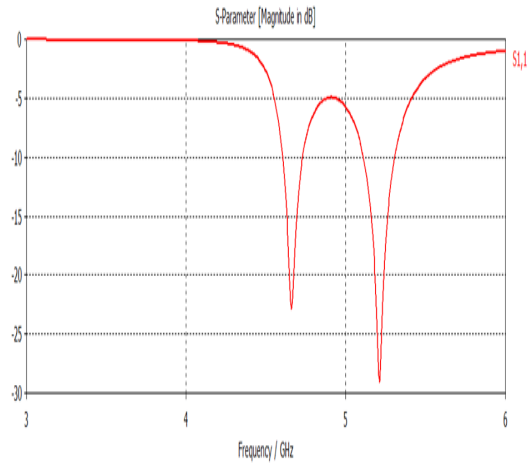

Fig 2: Simulated Return Loss

In the figure 2, we got return loss(S11)= -29.04 dB and (5.4082-5.212)=196 MHz bandwidth at 5.4GHz frequency and return loss (S11)=-22.77 dB and (4.73-4.60)=130 MHz bandwidth at 4.6GHz.

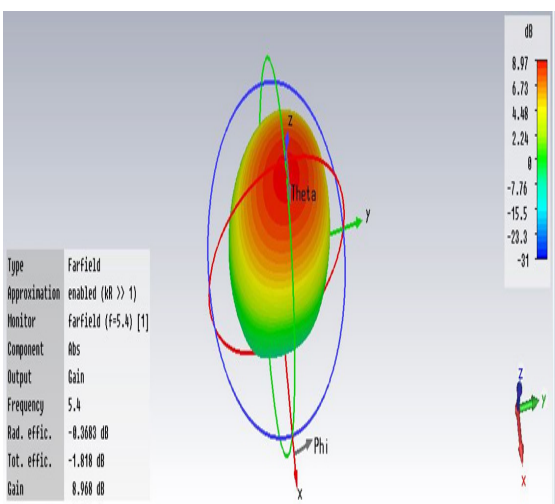

Fig 3: 3D Radiation Pattern and Gain

Fig 3: shows the radiation pattern along with the gain and directivity. The radiation efficiency of the antenna is 92%.

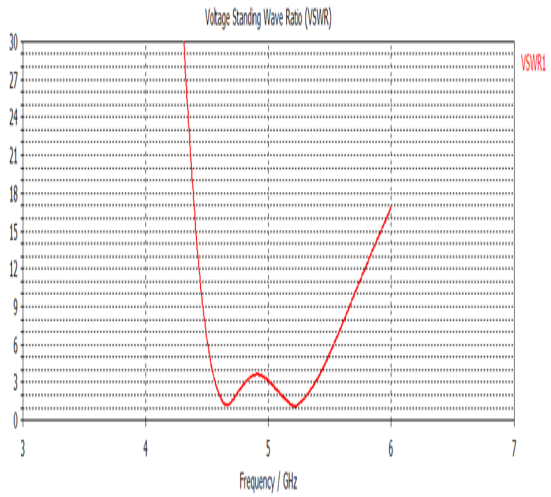

Fig 4: Voltage Standing Wave Ratio

Figure 4 shows the obtained voltage wave standing wave ratio for the above antenna.

CONCLUSIONS

A series-fed microstrip patch antenna has been designed for wireless LAN application operating at 5.4GHz. The two rectangular patch element with series-feed helps us to achieve dual band and the antenna was fabricated by using RT Duroid 5880 substrate to obtain the wide operating bandwidth.

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