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Analysis And Design Of Microstrip Patch Antenna For Wireless Applications

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Abstract: During the last few years wireless technology has gained so much importance and widely developed in image, speech and data transfer. This communication purpose need antenna to cover all the possible frequency bands. This paper presents the design of single band microstrip patch antenna with band pass filter. Here the filter is used to allow the required frequency and to remove the noise. The presented works includes the design of an antenna sandwiched with FR4 substrate of thickness 1.6mm and dielectric constant 4.4. The proximity coupling is used because of larger bandwidth and has low spurious radiation. The antenna is simulated to cover Worldwide Interoperability for Microwave Access (WiMax) channels (15 GHz). The antenna parameters are discussed and simulated using CST (Computer Simulation Technology) Studio Suite. This paper presents a low-cost printed circuit board (PCB)-based single-band antenna for future wireless local area network (WLAN) applications.

Keywords – Microstrip, WiMax, WLAN, VSWR

I. Introduction

Antennas are needed for every transmitter and receiver whether in either hidden form or protected as in radio and laptops which are equipped with Wi-Fi or in some other common systems. An antenna is also defined as the transformational structure between the guiding space and free space. The main use of radio transmitters and radio receivers is to carry signals or data towards the systems which includes Wi-Fi, remote controlled instruments and point to point transmission links. All systems would require an antenna that is non bulky and occupies less space. One such antenna is Microstrip Patch Antenna. A microstrip antenna generally consists of a dielectric substrate sandwiched between a radiating patch on the top and a ground plane on the other side. The patch is generally made of conducting material such as copper or gold and can take any possible shape. The dielectric constant of the substrate ϵr is typically in the range $2.2 \leq \epsilon r \leq 12$. [1-13]. Various types of antennas are proposed to cover these frequency bands, such as dipole, monopole, dielectric resonator antenna (DRA), patch, and planar inverted-F antenna (PIFA). In this paper, we propose a single band antenna fully covering WiMax bands (10.5 GHz). And also the antenna has designed with the filter in order to allow the required frequency and to remove the noise & the filter we used band pass filter. A BPF also provides different techniques for bandwidth enhancement. The additional filters are able to achieve desired frequencies and also provide a broadband operation at high frequency.

II. Antenna Structure

A microstrip patch antenna is a low-profile antenna that has a number of advantages over other antennas. The antenna consists of a microstrip feed line, a substrate, filter and a ground plane. The configuration of the proposed single band antenna is designed and fabricated on a substrate with FR4, relative permittivity of 4.4. This antenna support the resonant frequency 15 GHz for WiMax applications. The two F shape filter is used in order to allow the required frequencies. The proximity coupling feed is given at the microstrip feed line shown in figure 1. Side view of proposed antenna shown in figure 2.

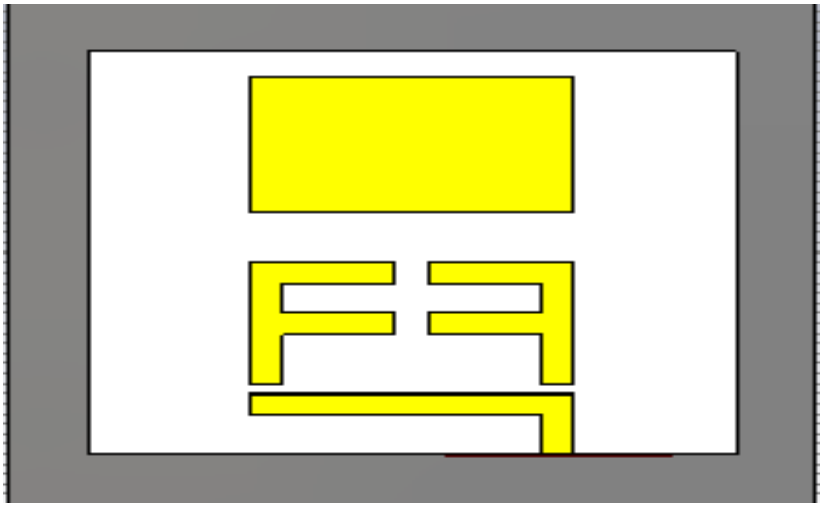

Fig.1 Structure of 15 GHz antenna (Top view)

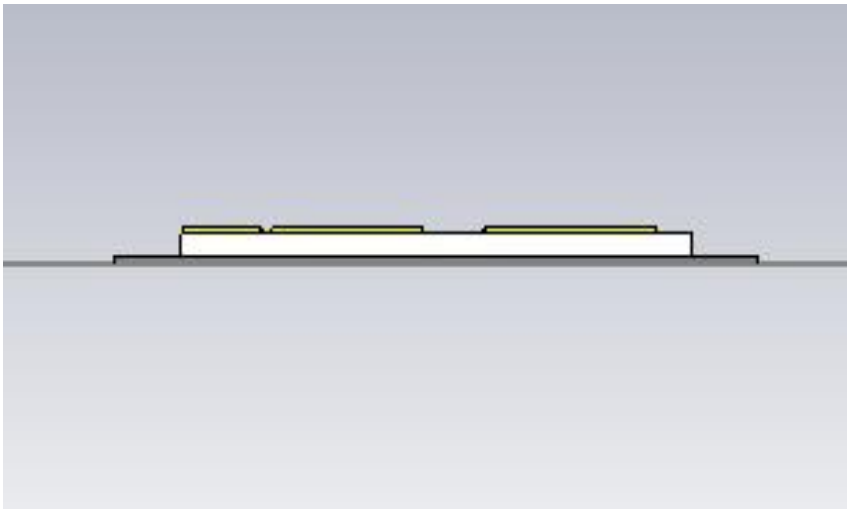

Fig.2 Structure of 15GHz antenna (Side view)

PARAMETERS	DIMENSIONS
Substrate length	40 mm
Substrate width	40 mm
Substrate thickness	1.6 mm
Patch length	14 mm
Patch width	20 mm
Patch thickness	0.6 mm
Dielectric constant	4.4
Feed length	6 mm
Feed width	2 mm
Feed thickness	0.6 mm
Filter length	12 mm
Filter width	2 mm

The dimensions taken to design above the rectangular patch antenna are shown in Table.1

Table.1 Dimensions of the proposed antenna at 15 GHz

III. Results

From the s-parameter graph we can infer that whether the antenna is radiating or not, and also graph tells that how much power is reflected from the antenna.This is called return loss or reflection coefficient.

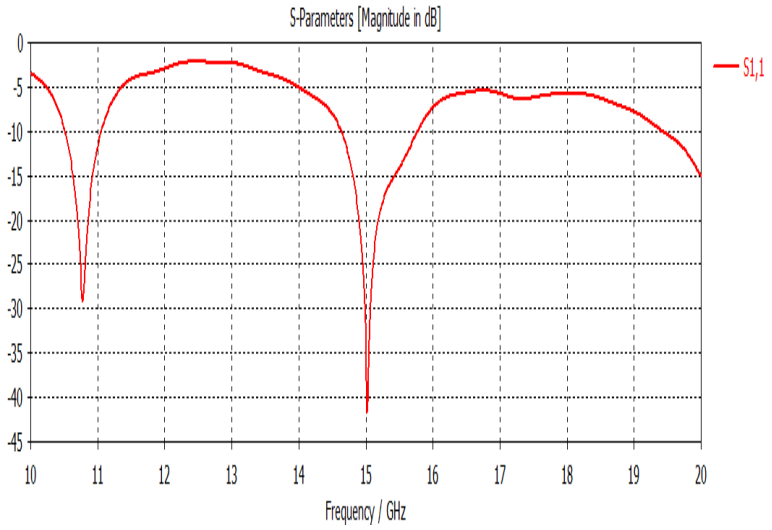

Fig.3 Return loss of proposed antenna at 15 GHz

A. Return loss

Figure 3. shows the return loss of microstrip patch ,it is resonating frequency at 15GHZ and reflection coefficient is increasing with increasing frequency. The return loss of the microstrip patch antenna is obtained about -43dB,also it offers good impedance matching.

B. Bandwidth

The bandwidth of the antenna describes the range of frequency over which the antenna can properly radiate or receive energy. For microstrip patch antenna bandwidth obtained is about 1.34GHz. Bandwidth the rate of data transfer, bit rate or throughput, measured in bits per second.

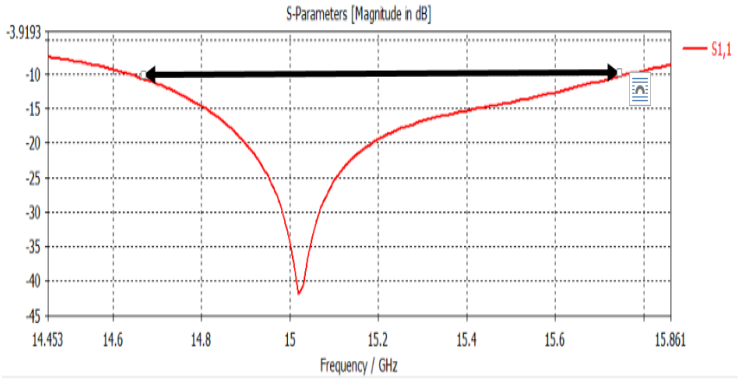

Fig 4 Bandwidth calculation

From graph as shown in figure 4 after identifying -10dB line we get two points i.e. low and high frequency of band.

Here we get,

Low frequency = 14.6.36 GHz
High frequency = 15.77 GHz
Bandwidth = 1.134 GHz

C. Gain

Radiation pattern of the antenna shows the graphical representation of radiation properties of the antenna. The 3D radiation pattern of antenna is shown in the fig.5.For microstrip patch antenna it has directional radiation pattern. That is this antenna radiates power in omni-direction.

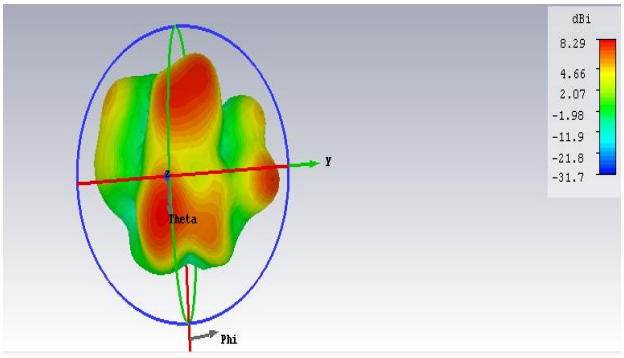

Fig.5 3D plot of gain at 15 GHz

D. VSWR

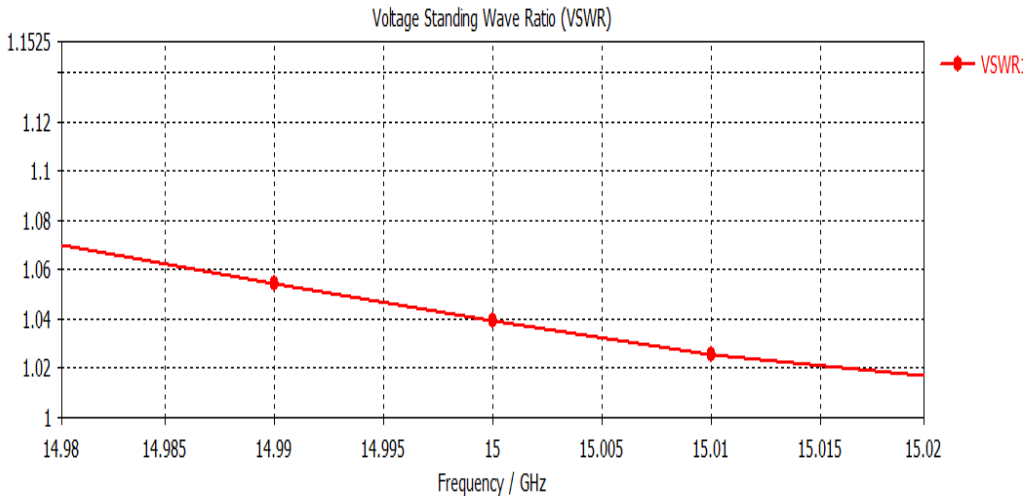

Fig.6 VSWR of the proposed antenna at 15 GHz

IV Conclusion

In this paper, the microstrip patch antenna using proximity coupled technique is discussed for WiMax applications. Compared to many antennas proposed earlier, this antenna is designed based on a rather simple structure with filter inbuilt. This design has various applications in electronic devices, mobile phones and Satellite communication. At these frequency bands, the antenna demonstrates good radiation performance for mobile device applications. The antenna is fabricated using a substrate FR4 of thickness 1.6mm and dielectric constant 4.4. The antenna 15 GHz band with enhanced bandwidth. The filter-antenna provides good selectivity and rejection in out of band regions. In addition, the proposed antenna shows enhanced parameters in the single operating bands, so it can emerge as an excellent candidate for multiband generation of wireless. These antennas might replace existing antennas in different products in future.

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