High Gain Slot Antenna for Ism and Wireless Applications

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ABSTRACT
A patch microstrip antenna for the application of WLAN technology is constructed. The antenna has a frequency bandwidth of 1 GHz (2.42GHz – 3.5GHz). The microstrip antenna which is made has a planar dimensions and consists of , a substrate, a patch,a ground and a feed. The general theory and its design are studied, and simulated using I3ED commercial software . Results show that the proposed antenna has promising characteristics for ISM Band at 2.45GHz frequency.

General Terms
Microstrip Line Feed, Single Frequency.

Keywords
Microstrip patch Antenna,IE3D, WLAN Communication Standard.

1. INTRODUCTION
The microstrip antenna have a number of beneficial properties likes small size dimension, low-cost of fabrication, low profile, light weight, easiness in installation and easy integration with feed networks but one of the serious drawback of these antennas have been their narrow bandwidth characteristics as it limits the frequency spectrum over which the antenna can perform properly. All the above characteristics are major design considerations for useful applications of microstrip patch antennas. Recent technological developments enables the wireless communication operated devices to become physically smaller in dimensions. Size of antenna is without question a major criterion that limits miniaturization. With the fast growth of the wireless mobile communication technologies, the future technologies need a very miniature size antenna. Wireless local area network (WLAN) and Worldwide Interoperability for Microwave Access (Wi-MAX) technology are the most rapid growing fields in the modern wireless communication [1]. This allows the users the freedom to move in surrounding within a broad area and still be connected with the network. It provides highly increased freedom and flexibility of operation. Wireless has become widely used because to ease of installation, and locational freedom. Exactly, these applications generates the requirement of antennas.[3] Because of this being the case, portable antenna technology has rapidly grown along with cellular technologies and mobile technologies. It is essential to have an appropriate antenna for a device. The proper small size antenna will improve the quality of transmission and reception of signal, decrease the consumption of power , last for longer duration and improve the quality of the devices use for communication . In this research paper, a single band microstrip patch antenna is designed for WLAN applications and it is stimulated using IE3D software. The proposed patch antenna made resonates at GHz frequency range.

2. DESIGN OF MICROSTRIP PATCH ANTENNA
In this design the length of the slot antenna (L1+L2+W) is 75mm and the width of slot (H1,H2) is 11.5mm. For match impedance with characteristic impedance of transmission line50ohms, the gap (W1) and the width of the center conductor is are 0.5mm and 2.4mm. This antenna is designed on RT/Duroid 5880 with dielectric constant 2.32 and with the thickness of 1.6mm. The total length (L) and the total width (w) of the antenna are 87mm and 65mm. It can be fed by different methods like microstrip feed line , coaxial feed probe , aperture couple, electromagnetic wave couple and coplanar waveguide (CPW) couple. Antenna is designed for a resonating frequency of 2.45 GHz and is analyzed using I3ED software. For the designing of rectangular microstrip antenna, the following relationships are used to calculate the physical dimensional parameters of rectangular patch microstrip antenna [4].

$$\varepsilon_{\mathrm{reff}} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12\frac{h}{W}\right]^{-\frac{1}{2}}$$

$$L_{eff} = \frac{c}{2 f_o \sqrt{\varepsilon_{reff}}}$$

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

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

$$f_r = \frac{1}{2L\sqrt{\varepsilon_r \varepsilon_o \mu_o}} = \frac{v_o}{2L\sqrt{\varepsilon_r}}$$

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

$$L_g = 6h + L$$

$W_g = 6h + W$ where,

h	= substrate thickness
L	= length of patch
L_{eff}	= antenna effective length
W	= width of patch antenna
c	= speed of light
f_o	= Resonant frequency
ε_r	=relative permittivity
ε_{reff}	= effective permittivity
L_g	= Length of ground plane

W_g = Width of ground plane

3. DESIGN PARAMETERS

Figure 1 show the frontal view of the structure made on I3ED software of proposed patch microstrip line fed antenna with only a single band operation for the application such as WLAN .The location of the feedpoint and the dimensions for antenna have been accurately optimized inorder to get the best possible antenna impedance match . The following are the parameters which have been used for the designing of proposed antenna.

Design frequency	= 2.45GHz
Substrate permittivity	=2.32
Thickness of substrate	=1.6 mm
Length of patch antenna(L)	= 75 mm
Width of patch antenna(W)	= 11.5mm
Length of ground (Lg)	= 84.6mm
Width of ground(Wg)	=21.5mm

4. ANTENNA DESIGH AND SIMULATED RESULT

Fig 1 shows the antenna design simulated using the I3ED software. The S11 parameters for the designed antenna were calculated and the simulated return loss results are shown in Figure 2. The bandwidth at the resonating frequency 2.45 GHz is 1 GHz with the corresponding value of return loss as -10 dB. The bandwidth of 1 GHz is achieved as shown in Figure 2. The antenna covers the ISM band and wireless applications. The achieved value of return loss is small enough and frequency is closed enough to the specified frequency band for 2.45 GHz WLAN applications. The return loss value i.e. -13.5 dB suggests that there is good matching at the frequency point below the -10 dB region. The VSWR ratio is 1:1.032 is shown in Figure 3, which should lie in between 1 and 2.

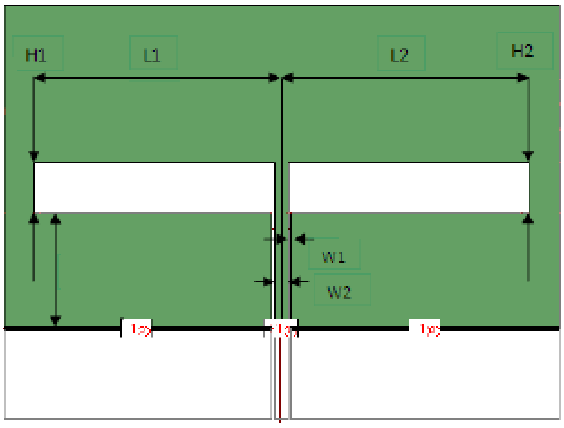

Fig.1: If necessary, the images can be extended both columns

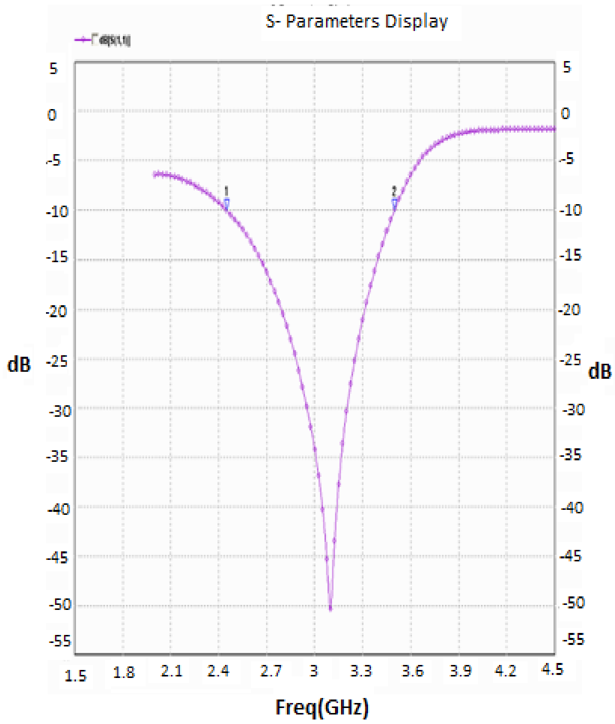

Fig.2: Return Loss Curve

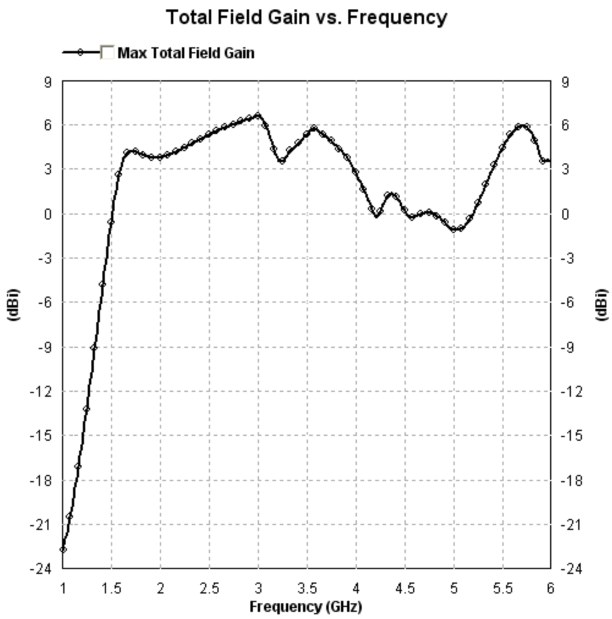

Fig. 3: Maximum Gain of the Antenna

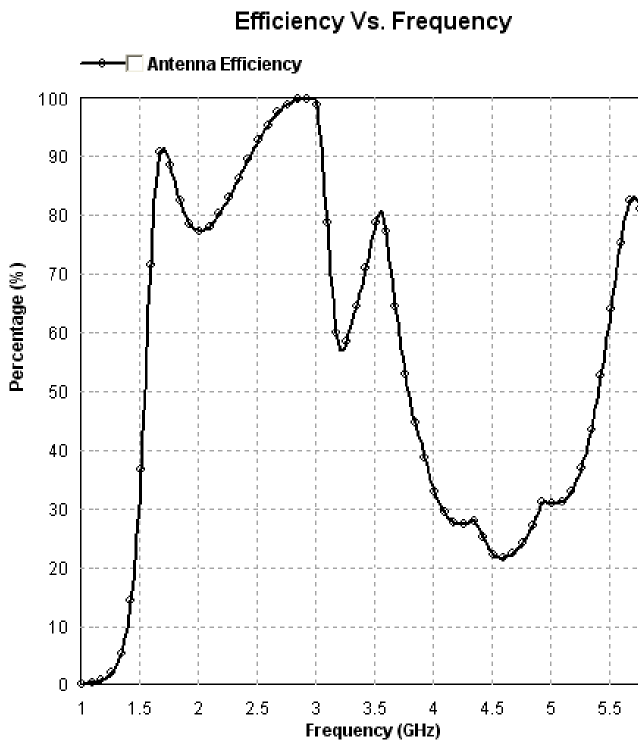

Fig.4: Antenna efficiency of the antenna

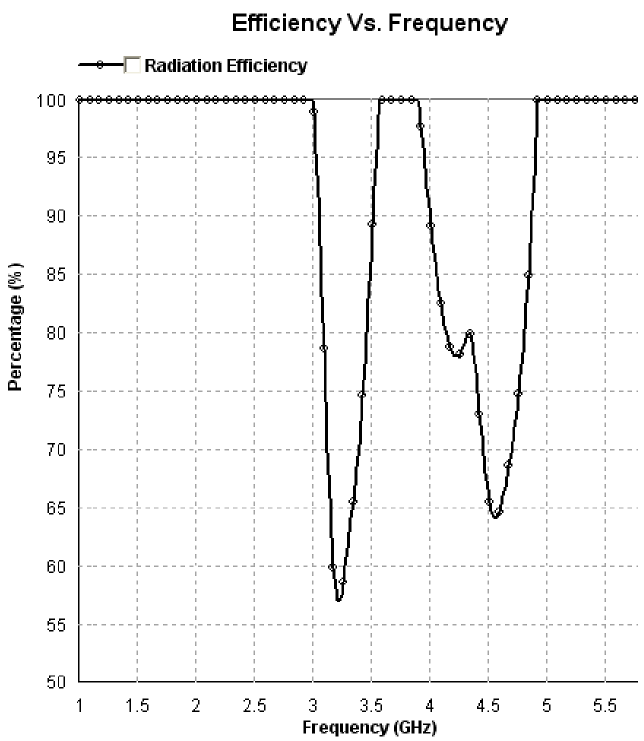

Fig.5: Radiation efficiency of the antenna

CONCLUSION

A microstrip line fed single frequency microstrip patch antenna has been designed and simulated using I3ED software. This is operating in the frequency band of 2.42 GHz – 5 GHz covering GHz WLAN communication standard. The simulated impedance bandwidth at the 2.45 GHz band is around 1 GHz with the corresponding value of return loss as -12.5 dB which is small enough and frequency is closed enough to the specified frequency band feasible for WLAN application. This return loss value i.e. -12.5 dB suggests that there is good impedance matching at the frequency point below the -10 dB region. The antenna also shows a maximum gain at 2.45 GHz frequency band of wireless communication with a good impedance matching of 50 ohm. However, the size of the microstrip antenna, reported here, is not very small. Cutting inclined slots on the patch, the size of the microstrip antenna may be reduced, also the bandwidth may be enhanced. Work is going on to achieve even better results with good axial ratio over a wide bandwidth.

5. ACKNOWLEDGMENTS

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6. REFERENCES

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