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DESIGN OF DUAL- BAND PATCH ANTENNA FOR ON-BODY APPLICATION

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Abstract-*In this upcoming world antenna plays an important role in fast developing wireless communication. This project focuses on the design of dual- band patch antenna and Wireless Body Area Network (WBAN)has attained a great interest in the field of communication, which helps in monitoring the human body activities. In the health care sector, the medical treatment to the patients becomes more accurate and efficient by the improved technologies. In WBAN, the body holds sensor which may be in body, on body or off body nodes over various region in order to monitor the body functionalities .The significant feature of this project is fabricating the patch antenna with Z shaped slot on a very thin substrate rogers RO4003C with the thickness of 0.2mm,so that the antenna will have high flexibility which makes it suitable for WBAN application and the antenna structure seems to be very compact.*

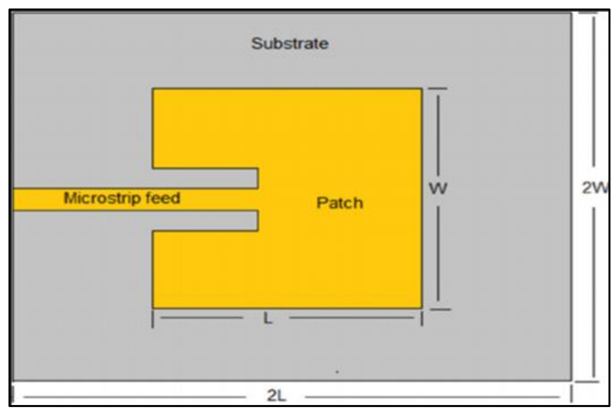
Keywords- CST Software, dual band, microstrip patch antenna.

I. Introduction

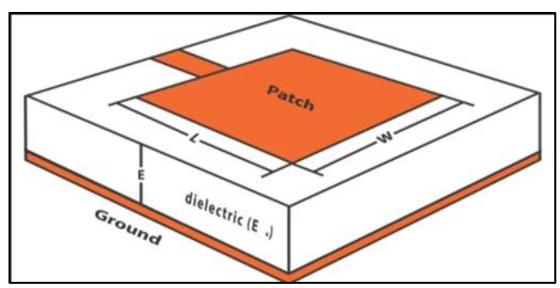
Multiband antenna plays an important role in wireless service requirements in this rapidly changing world within wireless communication system. The new trend is to build low-cost, low-profile antennas that can sustain high efficiency over a large frequency spectrum.. Slotted micro strip patch antenna structure are commonly used for the realization of microwave, radar and communication multimeter wave monolithic integrated circuits.. Within this operating range of frequency, the antenna should have stable response in terms of gain, radiation pattern, polarization etc.

At the same time, it should be compact, simple, low cost and it should be easily integrated into the RF circuits. The slotted micro strip patch antennas has dielectric substrate, with a ground plane on the other side. The size and frequency inversely proportional in slotted micro strip patch antenna. Antenna plays a major role in wireless communication. The dimension type and configuration of the antenna depends on the application and the operating frequency. Antenna defined as means of transmitting and receiving radio waves.

It proposed a small size printed planar inverted –F antenna (PIFA) operated at its 1/8 wavelength (λ18) mode has the fundamental resonant mode for achieving WWAN (wireless wide area network) operation presented [1]. It examined multiband written monopoly slot antenna promising to act as an internal antenna in Wireless Wide Area Network (WWAN) service of the thin-profile laptop computer[2]. It proposed a high-gain, three-antenna system ideal for concealing multiple-output multi-input wireless access points within (MIMO0 device in WLAN 2.415.215.8GHz bands [3].It investigated novel compact ultra-wide band (UWB) printed slot antenna with three extra bands for various wireless application is presented [4].In the design of compact patch antennas equipped with complementary split-ring resonator (CSRRs) and reactive impedance surface (RIS) underwent a test [5].



(a)



(b)

Fig.1.1 (a) A Micro strip Patch Antenna with Feed

(b) 3D view of Micro Strip Patch Antenna

II. Feeding Techniques in Antenna

A. Feeding Techniques

Micro strip patch antennas can be fed using a range of different methods. These methods can be classified into two categories they are contacting and non contacting. In the contacting method RF power is fed directly to the radiating patch using a connecting element such as micro strip line and radiating patch. The feeding techniques used are the micro strip line, coaxial probe aperture coupling and proximity coupling.

B. Micro Strip Feed line

In this kind of feeding technique, a conductive strip is directly connected to the edge of the micro strip patch. The conducting strip is smaller in width as compared to the patch and this type of feed arrangement has the advantage that the feed can be etched on the same substrate to provide a planar structure. The inset cut seen in the patch has to match the impedance of the feed line to the patch without need for any extra matching element. By properly managing the inset location, this can be done. The thickness of dielectric substrate increases surface waves and spurious feed radiation increases. The radiation from this feed also causes undesired cross polarizedradiation.

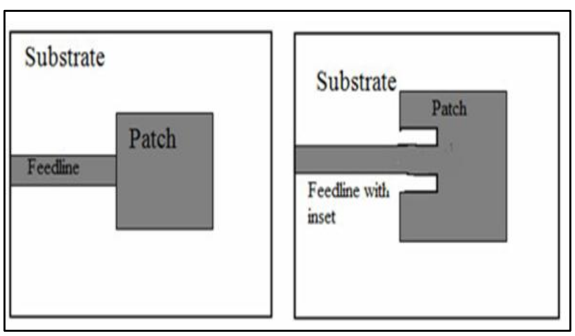
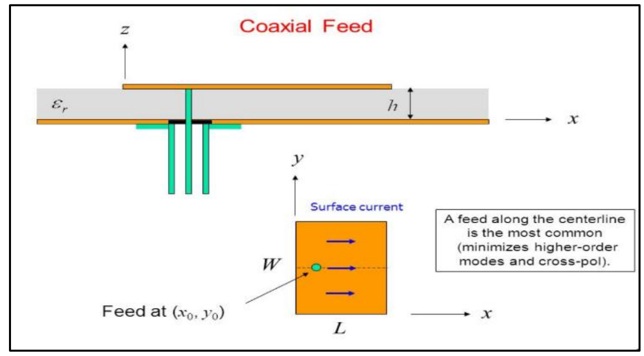


Fig.2.1 (a) Micro strip feed line

C. Coaxial Feed

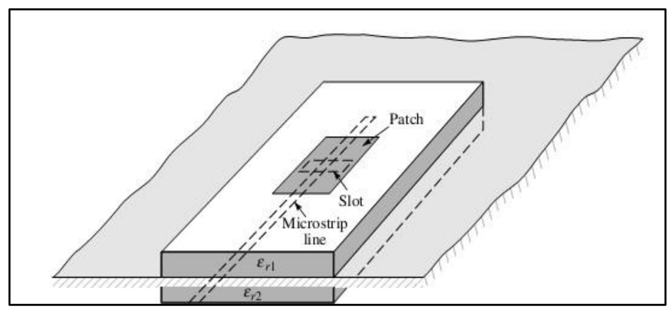
This feed is common technique used for feeding micro strip patch antenna. The coaxial connector's inner component passes through the dielectric and is sold to the radiating patch while the outer conductor is attached to the ground plane.. The feed can be placed at any desired location inside the patch in order to match with its input impedance and this is its advantage. This feed is easy to fabricate. The drawback found here is that it provide narrow bandwidth and is difficult to model.



(b)

D. Aperture Coupled Feed

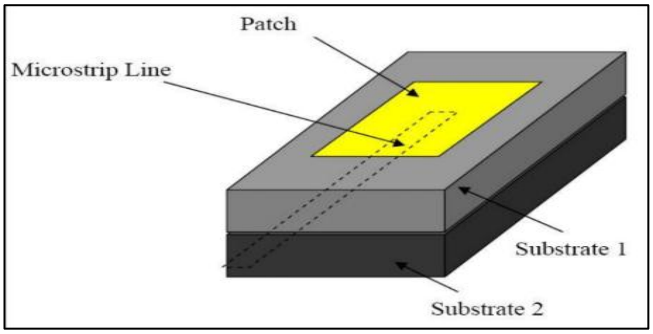
In this feed technique the radiating patch and the micro strip line are separated by the ground plane. The coupling present between the patch and the fed line is done through a slot or an aperture in the ground plane.



(c)

E. Proximity Coupled Feed

This feed is also called as the electromagnetic coupling scheme. There are two dielectric substrates used in which the feed line is between the two substrates and the radiating patch is on top of the upper substrate. The benefits of using this feed technique is that it eliminates spurious feed radiation provides very high bandwidth.



(d)

Fig.2.2 (b) Coaxial Feed (c) Aperture Coupled Feed (d) Proximity Coupled Feed

III. Design Equation

1) To calculate wavelength:

λ = c/f
c- Velocity of light (3x1011mm)
λ-Wavelength
f-Resonant frequency

2) Calculate width of the patch

$W=\frac{c}{2f\sqrt{(\varepsilon r+1)/2}}$
εr-Dielectric constant
W- Width of the patch

3) Calculate effective dielectric constant

$\varepsilon reff = \frac{\varepsilon r+1}{2} + \frac{\varepsilon r-1}{2} + \left[1+\frac{12}{W}\right]1/2$
εreff - Effective Dielectric Constant
h- Thickness of the patch

4) Calculate Normalized Extension in length

$\Delta L = 0.412h\frac{(\varepsilon reff+0.3)\left(\frac{W}{h}+0.264\right)}{(\varepsilon reff-0.258)\left(\frac{W}{h}+0.8\right)}$
ΔL- Normalized Extension in length

5) Calculate Effective length

$Leff = \frac{c}{2f\sqrt{\varepsilon reff}}$
Leff- Effective Length

6) Calculate the length of the patch

L= Leff- 2ΔL
L- Length of the patch

7) Calculate the length and width of the substrate

Lg= L+6h
Wg= W+6h
Where $h=\frac{0.0606\lambda}{\sqrt{\varepsilon reff}}$
Lg- Length of the substrate
Wg- Width of the substrate

8) Calculate the guided wavelength

$\lambda g = \frac{\lambda}{\varepsilon reff}$

9) Calculate feed length

$Lf = \frac{\lambda g}{4}$
Lf- Feed length

10) Calculate feed width

$Lw = \frac{1}{2}Lf$
Lw- Feed width

IV. Design Parameter of Proposed Antenna

Parameters	Dimensions(mm)
L	33.65
W	41.76
fo	6.85GHz
T	0.2
Lg	26.0457
Wg	30.721
H	2.654

Frequency of operation (fo): The resonant frequency of the antenna must be appropriately selected. For multi band operation 3.1GHz-10.6GHz frequency range should be selected. Hence the antenna designed must be operated at high frequency range.

V. Design Specification

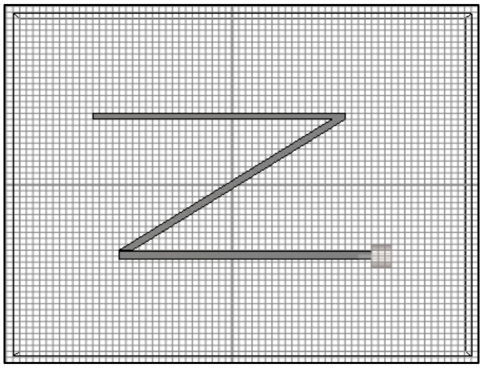


Fig.5.1 (a) Z slotted antenna

The proposed antenna is designed by cutting single slot in patch to make it a slotted antenna. Cutting of slots in antenna increases the current path which increases the current intensity, as a result efficiency is increased. The basic structure of antenna consist of ground plane, substrate, patch and fed line. The transmission line is the preferred method of analysis for calculating the various dimension of the slotted micro strip patch antenna.

The width of the micro strip patch antenna is 41.46 mm. The length of the patch antenna is 33.65 mm. The dielectric constant is 3.38 mm.
And the length of the substrate is 26.0457mm and width of the substrate is 30.721mm.

VI. Simulation Result

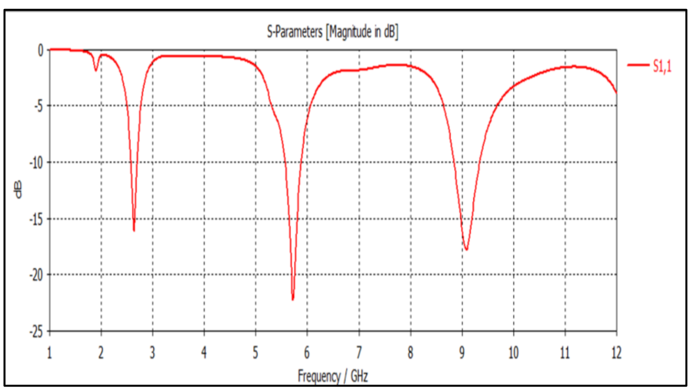


Fig.6.1

VII. Discussion

In every antenna design, simulation is always an important step. All the study of parameter can be predicted before it is to make changes. Simulation is done using CST software. The characteristic of proposed antennas have been investigated through different parametric studies using CST software. The proposed antenna have achieved stable radiation pattern and satisfied return loss. This antenna design can be used for multiband applications.

VIII. Conclusion

A slot antenna in the radiator and partial ground plane has been designed and simulated. The proposed antenna exhibits bands, it supports for 3.1GHz to 10.6GHz as well as good radiation properties. Therefore this antenna suitable for Super High frequency application that works in these frequency. Slot antenna for multiband frequency application with MIMO technique is simulated. The antenna gain is boosted by coporate feed inset to feed lines. With the goal that it can be utilized for future 5G remote correspondence.

IX. References

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