Ψ Shape Slotted Wearable Microstrip Patch Antenna for Dual Band

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ABSTRACT
This paper presents a Ψ shape slotted wearable probe fed microstrip patch antenna for dual band. In this paper a new design of antenna that resonates at 3.39 GHz with the bandwidth of 139 MHz and also resonates at 4.87 GHz with the bandwidth of 251 MHz is presented. The simulated results along with the different parameters like radiation pattern, VSWR etc. are presented and discussed in this letter. The design and performance of antennas are carried out using HFSS 14.0 software. Main objective of this paper is to achieve the multiple resonances within the same antenna at desired frequencies so that this could be applicable in S and C band applications using polyester cloth as a substrate.

Keywords
Microstrip Patch Antenna, Reflection Coefficient, HFSS (High Frequency Structure Simulator).

1. INTRODUCTION
With the rapid growth of wireless technology, wireless users hope the speed and service they have from wired connections such as internet access. Future trend in wireless communication is higher data rate or system capacity. To meet the requirement of future application, improvement in the quality of wireless link is essential. Wearable antennas have drawn more and more attention in recent years as they can be integrated into human clothing.

In medical applications, biomedical smart clothing with multiple sensors have been introduced, such as VTAMN (France) which has been integrated with a breath rate, temperature and fall/shock biosensor with GSM/GPRS module into the clothes. WEALTHY (Europe) clothes have also been developed to monitor patient activity, to ensure safety and provide reassurance. Life Shirt (USA), a washable smart textile which includes EEG, ECG and blood pressure sensors, is built for cough and respiration monitoring. For military applications, a fiber-optic sensor has been integrated into soldier uniform to detect various hazards such as chemical, biological and thermal ones [1, 2].

Wearable antennas need to be flexible, hidden and light weight, considering the convenience of the user. Therefore textile wearable antennas have become the focus of many antenna research efforts due to their flexibility, durability, and suitability for a wide range of applications such as objects surveillance, wireless medical applications or wireless communication.

Different textile/cloth based materials are used to manufacture these antennas such as cotton, , fleece fabric, foam, Nomex, nylon, polyester, conducting ribbon, insulated wire, conducting paint, copper coated fibric, geo textile etc. In literature, different wearable antennas have been reported [3]-[7]. These antennas have been fabricated on the various textile substrates for body centric communication systems that covers Wi-Fi, Wi-Max, WLAN, HYPER LAN, BAN, Bluetooth applications[8].

In this letter, a slotted antenna is proposed which is capable of dual band frequency operation for 3.39 GHz and 4,87 GHz applications. The design and performance of antenna are carried out using HFSS 14.0 software.

The rest of the paper is organized as follows: section two present the antenna structure and design. In section three, simulated result are discussed. The paper finishes with the conclusion in section four.

2. ANTENNA STRUCTURE AND DESIGN
The design of antenna 1is shown in figure 1. The rectangular patch has dimension of 30mm x 20mm. The dielectric material selected for this design is polyester cloth with dielectric constant (ϵ_r)=1.39and substrate height (h)= 3.14 mm[8]. The patch antenna is coaxially probe fed at (2.5,-4.5).

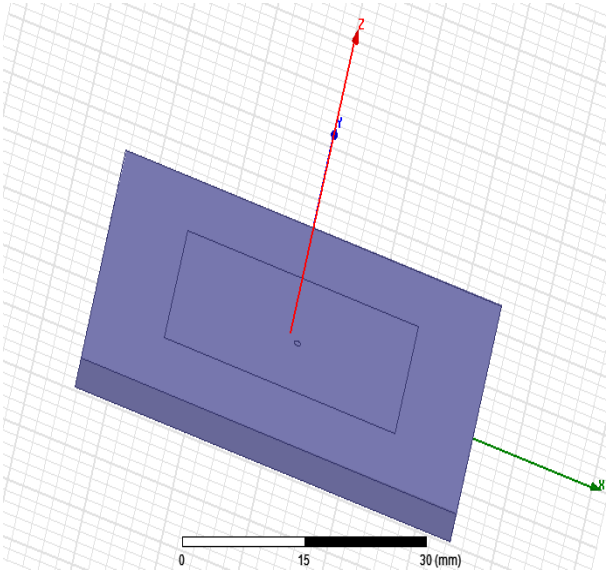

Fig 1: Antenna 1 design

Figure 2 shows design of antenna 2 which is designed with a sams substrate. All the dimension and position of feed is same as that of antenna1. In this design, slots are created on the rectangular patch at proper position and shape of slot becomes Ψ shaped as this slotting technique produces dual band and antenna resonates at 3.39 GHz and 4.87 GHz.

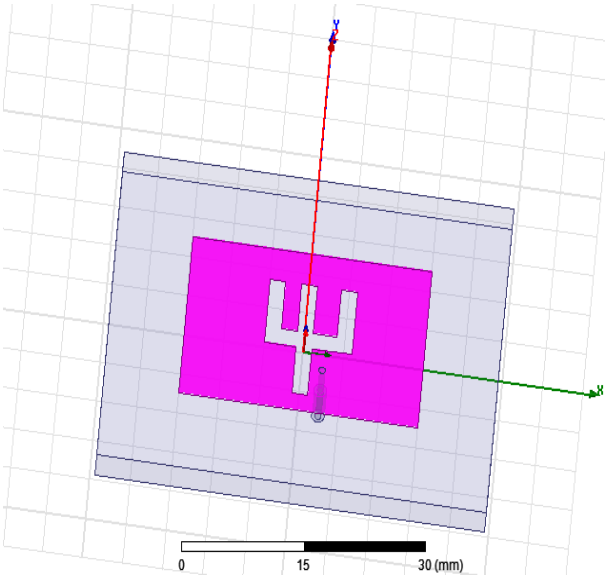

Fig 2 : Antenna2 design.

Table1. Parameters

Parameters	Antenna1 In (mm)	Antenna2 (mm)
Length(ground)	48.84	48.84
Width(ground)	38.84	38.84
Length(patch)	30	30
Width(patch)	20	20
Feed	(2.5,-4.5)	(2.5,-4.5)
Substrate Thickness	3.14	3.14

3. SIMULATION RESULT

The simulation is done using Ansoft HFSS (14.0). Different parameters like radiation pattern, Reflection coefficientS_{11}, VSWR is discussed given below.

3.1 Radiation Pattern

The radiation patterns of antenna2 design are shown below. As the antenna 2 resonates at two frequencies 3.39 GHz and 4.87 GHz, the radiation patterns at two different frequencies are shown at different angles of phi 0° and 90° in figure 3.

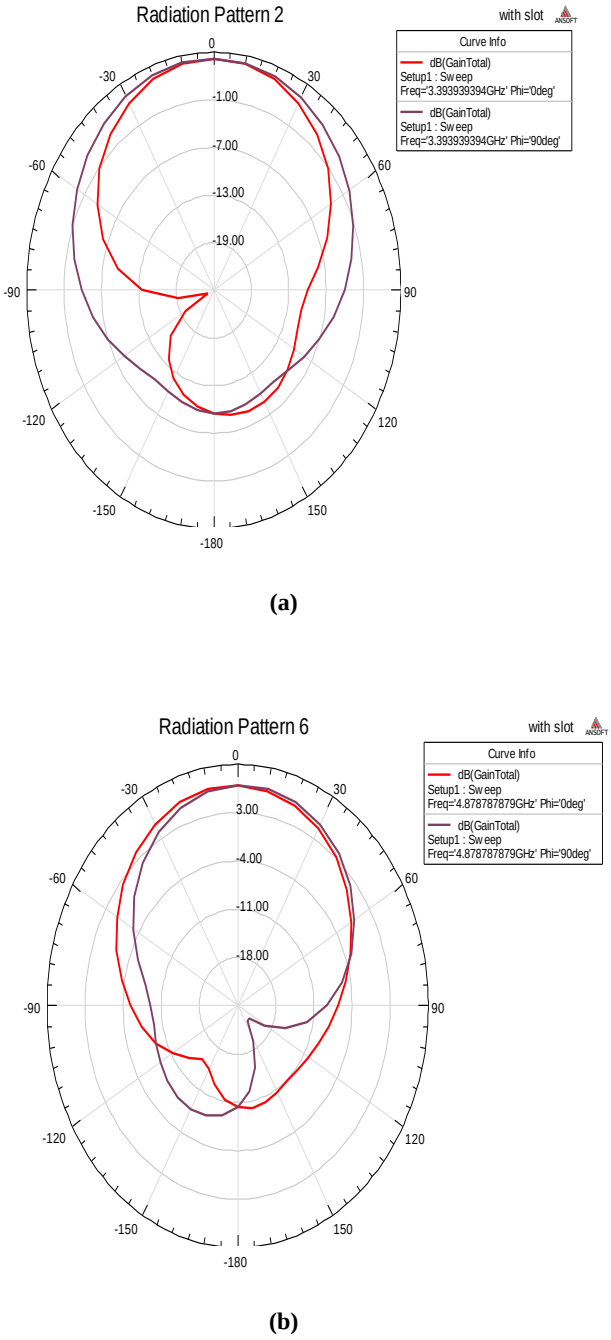

Fig 3:Radiation pattern of antenna 2 (a) freq. 3.39GHz (b) freq. 4.87 GHz

3.2 Reflection Coefficient

The slots on the patch are responsible for dual band operation as the slots perturbation on the patch changes the current distribution. The design of antenna 2 shows simulated reflection coefficient obtained at -26.39 dB and -25.85 dB that resonate at two frequencies 3.39GHz and 4.87GHz respectively as shown in figure 4.

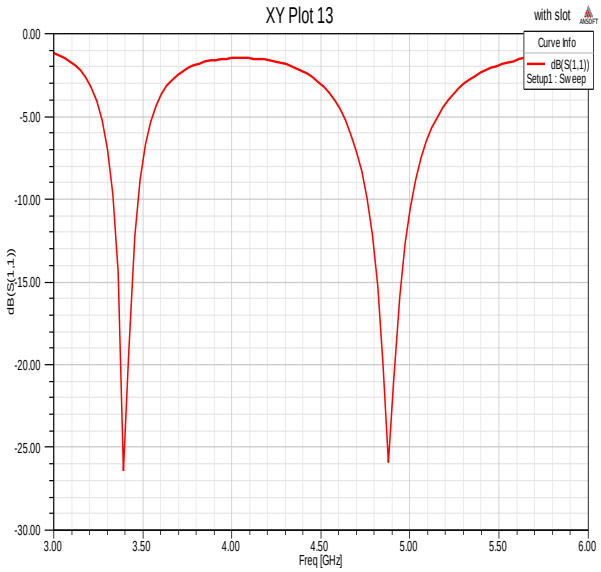

Fig 4: Antenna2

3.3 Voltage Standing Wave Ratio

Voltage standing wave ratio of antenna at their resonant frequencies shows the values which are less than 2 that are acceptable as shown in figure 5.

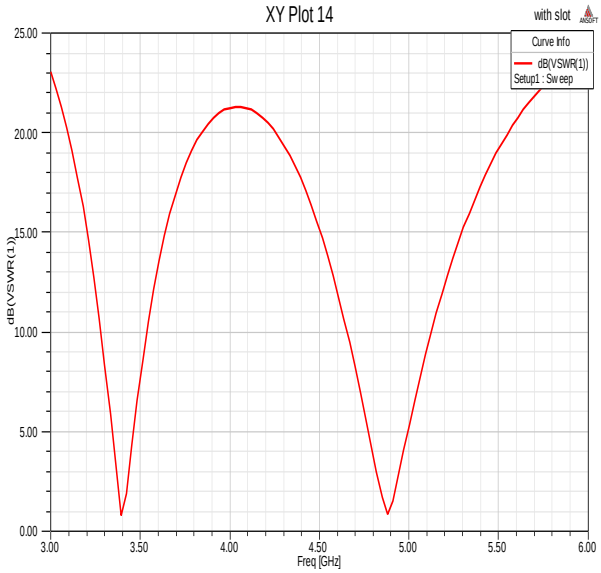

Fig 5: Antenna2

4. CONCLUSION

A new design of dual band wearable microstrip patch antenna is presented in this paper using polyester cloth as a substrate. A slotted Ψ shaped microstrip patch antenna fed by co-axial probe has been proposed in this paper. Also slot of Ψ shaped reduces the size of patch to some extent that leads to light weight and easily wearable. The proposed antenna2 is suitable for WiMAX and multi-frequency applications of wireless communication in S and C band as the design resonates at frequencies 3.39 and 4.87 GHz that shows its dual band operation. Different parameters are taken along with the radiation pattern.

5. ACKNOWLEDGEMENTS

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