Scientific Journal of Impact Factor (SJIF): 5.71

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

National Conference on Microwave & Optical Communication

Volume 5, Special Issue 08, May-2018

DESIGN OF DUAL BAND MICROSTRIP PATCH ANTENNA FOR WIMAX/WLAN APPLICATION

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Abstract— *In this paper, the design of microstrip patch antenna was proposed in which hexagonal shaped patch were introduced for dual band operation. This antenna consists of one radiating patch, two dielectric substrates i.e., top substrate and bottom substrate and set of T-shaped probes which establish the connectivity between the both substrates. The isolation between two ports is improved by using split ring resonator based structure as feeding network. The overall dimension of the antenna is 100× 100 ×13.2mm.The proposed antenna achieves -34dB isolation between two ports, the return loss are*
-21dB and -23dB over the operation band and desired impedance bandwidth is obtained. The proposed antenna is useful for wireless communication applications like WIMAX/WLAN. The antenna was designed and simulated by using HFSS simulation software.

Keywords— *Microstrip Patch Antenna, Port isolation, Impedance bandwidth.*

I. INTRODUCTION

Wireless communication systems, particularly mobile and satellite communication, have experience rapid improvement in the past years. In base stations, where the Uplink and Downlink channels occupy two separate frequency bands, the duplexer is often used for the transmitter and the receiver to share an antenna. The duplexer is typically required to have high isolation between the transmitting and receiving ports to reduce the channel interference.

Full duplex (Simultaneous Transmission and Reception i.e. STAR) communication is one of the essential operating modes in modern wireless communications. The STAR mode has the advantages of double data throughput and improved communication efficiency [1-3]. The main challenge in this type of system is to enhance the isolation between the transmitter (TX) and receiver (Rx) to reduce mutual interference.

To achieve high Tx and Rx isolation, the antenna integrated with triplexer have been employed to realize STAR performance [4] In base stations, where the uplink and downlink channels occupy two separate frequency bands, a duplexer is often used for the transmitter and the receiver to share an antenna. It is common to use antennas cascaded with duplexers or filters to distinguish the full-duplex communication. Due to the different bandwidth of the duplexer, filter, and the antenna, they are generally not well matched; then it will decrease the system performances of the system and also increase the size and weight of the overall system.

In the decade, diplexing antennas have been designed with dual-polarization for achieving high isolation. In [5], the anisotropic feature of photonic bandgap (PBG) structures was used in a dual linear polarization diplexer microstrip antenna exhibiting enhanced receiving/transmitting (Rx/Tx) isolation. Port isolation was comprehensively enhanced in [6] by placing a spiral-shaped defected ground structure (DGS) pattern under the feed line of a dual-frequency orthogonally polarized rectangular patch antenna.

In [7] a dual band filtering diplexing patch antenna is proposed. It utilizes microstrip resonators and a slot loaded patch to generate the Two-order bandpass filter response, resulting in high frequency selectivity and low interference between the Tx and Rx ports. In **[8]** an integrated filtering microstrip duplex antenna array with high isolation and same polarization was designed. A Transmission Line (TL) model is adopted to design the PDDN to achieve the functions of power division, frequency selectivity, and port isolation. The implemented antenna achieves an average gain of 10 dBi, a cross-polarization ratio of 20dB, and an isolation of 35 dB within the operation band.

II. DESIGN OF MICROSTRIP PATCH ANTENNA

The proposed Multilayer Patch antenna consists of one radiating patch, the two substrates i.e. top substrate and bottom substrate and two set of T shaped probes. The dimension of the substrate is (100×100×1.6) mm which is made up of using FR4 Epoxy dielectric material with Relative permittivity as 4.4 and relative permeability as 1 and two set of T-shaped probes are used between the upper substrate and lower substrate. An air gap with height of 2 mm is introduced between the two substrates. The Patch is printed at front side of the top substrate which has dimension as (48.4×48.4) mm is made up of using copper with thickness of 0.035mm.The overall dimension of the antenna is (100× 100 ×13.2)mm.

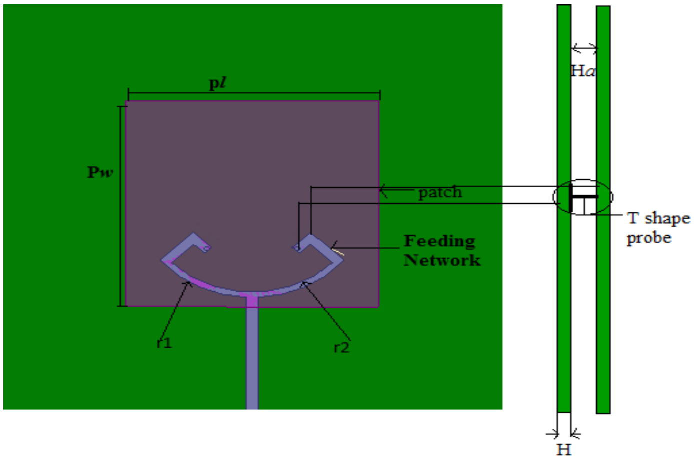

Fig: 1. Basic Patch Antenna

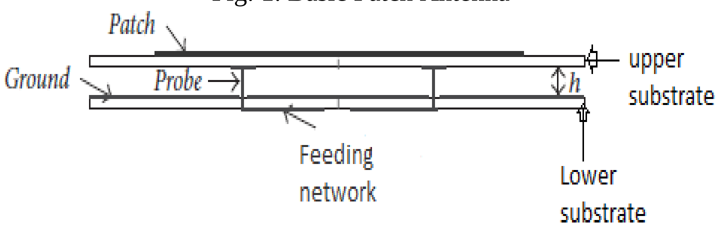

Fig: 2. Layout of Microstrip Patch Antenna

The T shaped probe consist of horizontal stripline and vertical metalized arm, the one end of the vertical metalized arm centrally connected with the horizontal stripline which is printed backside of the top substrate, and the other end is connected to the microstrip feeding network through a circle slot etched on the ground plane and a via-hole in the bottom substrate. The feeding network is printed on back side of bottom substrate. When the port is excited, the signal transmits through the feeding network to the T-shaped probes, then couples to the hexagonal shaped patch.

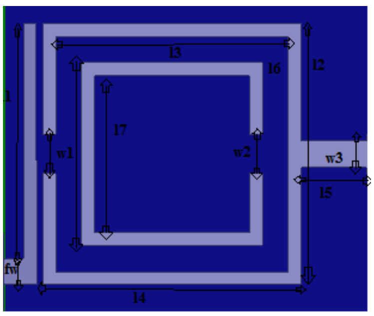

Fig: 3 Structure of Split Ring Resonator

The dimensions of the patch shown in Fig.1 follows: P*l*=48.4mm and W*l*=48.4mm.The horizontal stripline of the T-shaped probes are along the diagonal direction and symmetrical to the center of the patch. The above fig 3.a shows the parameters for lower channel filtering networks as: *f*w =2.25 mm, l1=17.75mm, l2=18mm, l3=13mm, l4=20mm, l5=2.3mm, l6=14m, l7=12mm, w1=1mm, w1=3mm, w2=3mm, w3=2mm.

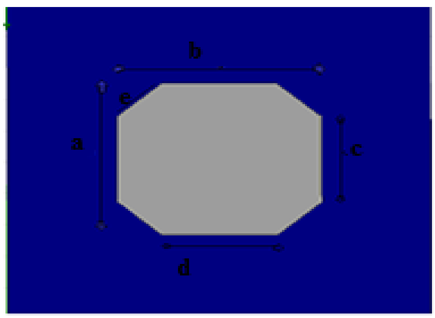

Fig: 4.a Front View

The hexagoanl shaped patch is placed in front side of the top substrate which is made up of copper with 0.035mm thickness.The dimension of the hexagoanal shaped patch is shown in Fig 4.a: a=48.4mm, b=48.4mm, c=27.2mm, d=27.2mm, e=15mm.

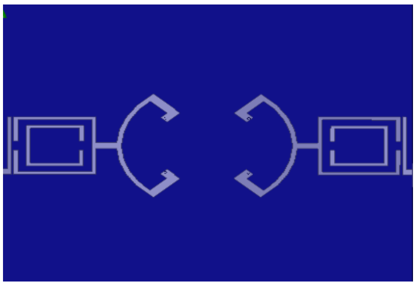

Fig: 4.b Rear View

III. RESULTS AND DISCUSSION

The following results shows the return loss and isolation between the two ports of the microstrip patch antenna using HFSS simulation software.

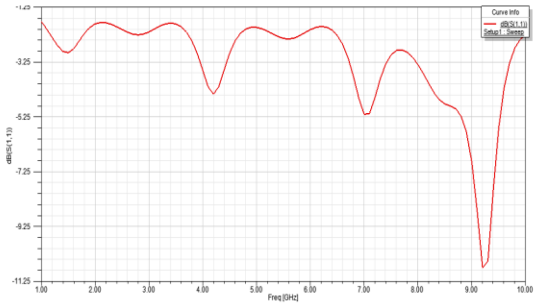

Fig: 5.a Return loss of basic Patch Antenna

The Basic broadband patch antenna produces -10.8dB at 9.2GHz with narrow band which is shown in above Fig: 5.a.

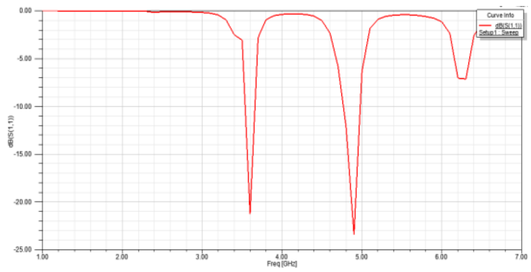

Fig: 5.b Return Loss of Microstrip Patch Antenna

In basic broadband antenna structure the square patch is modified into hexagonal shape and the slot loaded split ring resonator shaped feeding network are used to feed the microstrip patch antenna. The feeding network is placed in bottom substrate rear side which improves the isolation between two ports and hexagonal shaped patch increases the return loss of the antenna.

The return loss in the lower band is −21db and in higher band is −23dB which is shown in Fig 5.b. The impedance bandwidth of lower band is 3.6% (3.54−3.67GHz) and higher band 4.2% (4.77-4.98GHz) respectively.

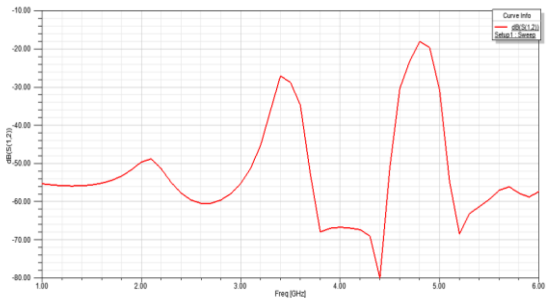

Fig: 6 Isolation between two ports

The above Fig: 6 illustrate the isolation between the two ports of the microstrip patch antenna. The isolation in the lower band is -34.7dB and in higher band is -19.6dB.

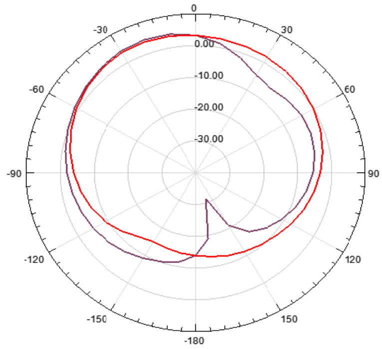

Fig: 7 Radiation Pattern

IV. CONCLUSION

The proposed Compact Microstrip Patch Antenna has been designed with two dielectric substrates, one radiating patch, four T-shaped probes and two set of resonators based feeding network. The return loss -21dB and -23dB for lower and higher band are obtained at frequency 3.6GHz and 4.9 GHz. The isolation between two ports are -34dB obtained using resonator based filtering channel as feeding network and the impedance bandwidth are calculated by using simulation results from HFSS simulation software. The proposed Microstrip patch antenna is useful for WIMAX/WLAN application.

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