IJARCCE

ISSN (Online) 2278-1021
ISSN (Print) 2319 5940

International Journal of Advanced Research in Computer and Communication Engineering
Vol. 4, Issue 12, December 2015

Enhancement of Isolation and Gain of Antenna Using Slotted Meander Line Resonator for WiMAX Applications

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Abstract: In this paper, method of moments based IE3D software is used to design a Microstrip Patch Antenna with Slotted meander line resonators. The aim of the paper is to design a Microstrip Patch antenna with slotted meander line resonator to enhance the isolation and gain of microstrip patch antenna. Microstrip patch antennas with mutual coupling are proposed for WiMAX applications. To reduce mutual coupling between patch antennas using different methods like Split Ring Resonators (SRR), Slotted Meander Line Resonators (SMLR), Wave Guided Metamaterials (WGMTM) structures are designed for WiMAX applications. The antenna is designed by applying FR4 substrate of thickness 1.6mm with permittivity 4.4 and obtained excellent isolation and improvement in gain.

Keywords: Microstrip patch antenna, SMLR, design, bandwidth, gain, efficiency.

I. INTRODUCTION

Microstrip antennas satisfy demands for small size, low weight installation in various devices with lack of space like mobile phones. Antennas are used in a moving device such that mobile, aircraft, satellite, missile etc. Square, rectangular and circular are the most common shape for microstrip antenna [1]. Microstrip patch antenna in a simplest form consist of a sandwich of two parallel conducting layer separated by a single thin dielectric substrate. Patch antennas are commonly used in the communications industry due to a various advantages. First, the directivity, gain and bandwidth parameter make it optimal for communications. Secondly, they exhibit Omni directional performance [2]. Coupling between antenna elements is a big problem so overcome the coupling effect suggest a suitable method to improve the performance of the antenna array. In this paper we are proposed slotted meander line resonators (SMLRs) [3]. In this, decoupling unit less space compared to electromagnetic band gap structures and using a single standard substrate. Patch antennas are easily analyzed with a variety of different models such as the transmission line mode, and cavity models. The main shortcomings of these antennas are narrow bandwidth and low gain [4]. These shortcomings can be overcome in by proper design of an antenna, and especially by using proper substrate thickness and dielectric constant.

II. DESIGN ASPECT

For designing a perfect antenna there are certain parameters that are to be considered that define the configuration of the antenna such as, return loss, gain, directivity, bandwidth, radiation pattern, input impedance, radiation efficiency, feed point location, smith chart and so on. Parameter in the software for the responses and simulation are Dielectric constant of the substrate (4.4), loss tangent (0.0013), thickness of the substrate (1.6mm) and highest frequency (8GHz). There is a response taken from the magnitude of return loss Vs frequency shown in figure 2 proposed antennas has minimum return loss at 5.757GHz. Here, in this paper ground substrate of length 50mm and width of 50mm. patch hieght from ground is taken 1.6mm. The proposed antennas designed with slotted meander line resonator. I obtained a triple narrow bandwidth SMLR creates a strong magnetic coupling with applied electromagnetic field [5]. Due to it can support resonant wavelength much longer than the diameter of the rings. This would not happen closed rings small gap produced large capacitance value lower resonant frequency. Split ring resonator has high quality factor and radiation losses. Techniques involve the use of slotted complementary split-ring resonator [6] waveguide Met materials. The idea of using meander lines for isolation enhancement has extracted from [7]. Slotted meander-line resonators (SMLRs) are proposed to be the decoupling unit that the decoupling unit has two sections of slotted meander lines cascaded and sandwiched between two arrays of patch antennas designed to work at 5.75 GHz.

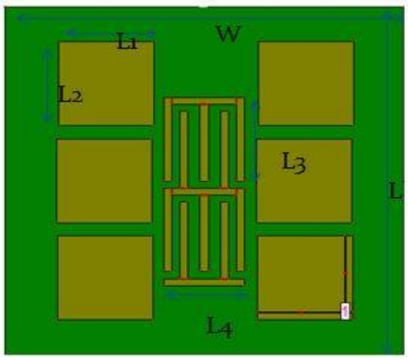

Figure.1 Front View of Proposed Antenna

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These SMLR structures act as a band stop resonator that specifically stops the surface current from one unit cell to another unit cell. The characterization of the SMLR decoupling unit and describes the surface current blocking mechanism [2]. Surface waves near fields lead to Detail specification of proposed antennas is given in table 1[6].

Table: 1 Dimension of the Designed Antennas

S. No.	Parameters	Values
1.	Resonance frequency f_r	5.757 GHz
2.	Dielectric constant ε_r	4.4
3.	Substrate height h	1.6 mm
4.	Patch width W	50mm
5.	Patch length L	50mm
6.	L1=L2	10 mm
7.	L3	12mm
8.	L4	10mm

A rectangular type slotted meander line resonator [11] designed with L3=12mm, L4= 10mm and width of strip is 1mm

III. RESULT AND DISCUSSION

IE3D software is first scalable design and verification platform. It is used for designing antennas, MMICs, RFID, IC Packaging and PCBs. IE3D by Zeeland Simulation Software, Inc. is simulation program that serves to analyze and optimize generally planar structures with possibility to model 3D metallic structures. The IE3D is a full-wave, method of moment (MOM) simulator solving the current distribution on 3D and multi-layered structures of general shape. Some of IE3D simulation results are Return loss, VSWR, Gain, Directivity, Smith chart, 2D and 3D Radiation pattern and so on. Antennas with known shape can thus be optimized. In this paper, S11 is a parameter which suggests how much power is radiated from load to the antenna. S_{11} parameter computation has been performed for microstrip patch antennas with SMLR structure. In figure 2 return loss of proposed antenna is -57.22dBi which is excellent response for isolation and enhancement of gain. Maximum isolation obtained at resonance frequency of 5.75GHz. Gain of proposed antenna improved as compared to [2] in this paper gain of antenna is 5.87dBi at 5.73GHz shown in figure3.

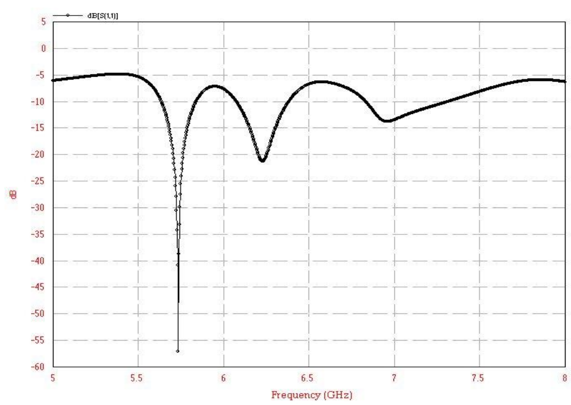


Fig.2: Return Loss Vs frequency for the Proposed Antenna

Efficiency of antenna is given in figure .4, it is maximum at 5.7GHz which indicate the good performance of antennas.

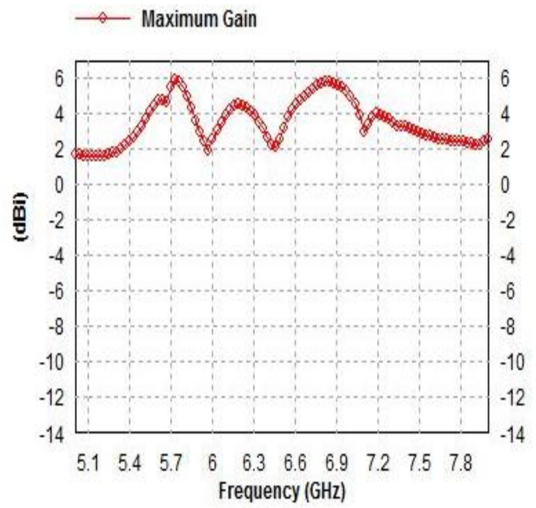


Fig. 3: Gain of Proposed Antenna

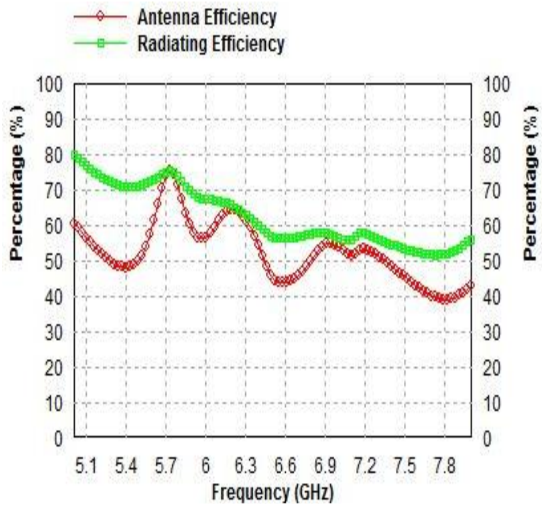
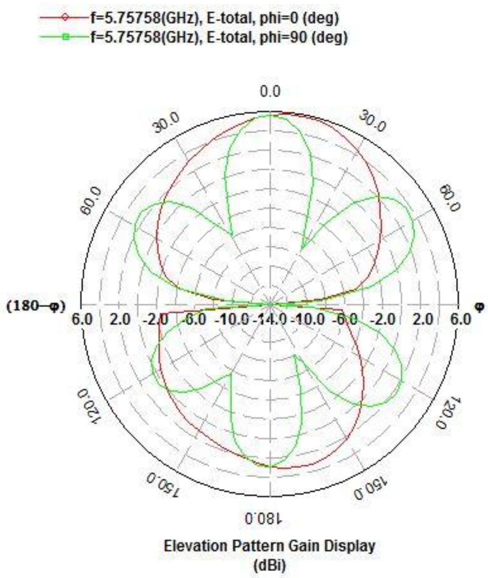
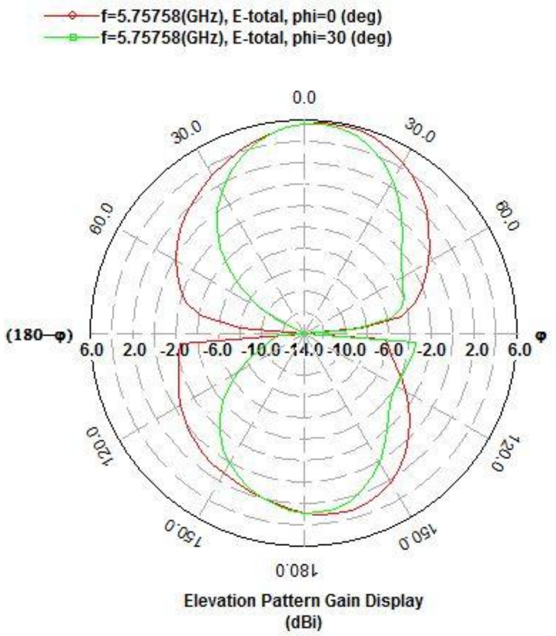


Fig.4: Efficiency of Proposed Antenna A



(a)



(b)

Fig.5: Radiation Pattern of Proposed Antenna

I calculate the radiation pattern at resonance frequency for ϕ=0 and ϕ=90 figure 5(a) shows that radiation is bidirectional for ϕ=0 and Omni-directional for ϕ=90. Second radiation pattern in figure 5(b) shows bidirectional for both values of ϕ=0 and ϕ=90.

IV. CONCLUSION

A Microstrip Patch Antenna has been successfully designed with SMLR. It can be concluded from the above results that, designing a proper feed network and impedance matching are very important parameters in Microstrip In this Patch antenna design, we increases the gain and isolation through SMLR sandwiched between arrays of two microstrip patch antenna structures. Isolation and gain of proposed antenna is affected by variation in width and length of slotted meander line resonator. It can be concluded from above result that slotted meander line resonator play an important role in designing of multiple band and enhancement of gain. It create strong magnetic decoupling with applied electric field so it make stop pass filter with resonance frequency of resonator. Different types of feed methods affect the performance of an antenna**.**

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