Middle-East Journal of Scientific Research 24 (5): 1658-1661, 2016
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2016.24.05.23261

A Microtsrip Patch Antenna for GPS/WIMAX Applications

Divya Mathew and J. Geetha Ramani

Department of ECE, SNS College of Technology, Coimbatore, T. N-641035, India

Abstract: An Inset-fed micro strip patch antenna is presented. A return loss better than -10 dB is achieved at the frequency bands GPS 1.227 GHz and WiMAX 2.5 GHz. The proposed antenna is printed on FR-4 substrate and it occupies the volume 72×60×1 mm^3. The simulated antenna has multiband operation and unidirectional radiation pattern.

Key words: Multiband · Global positioning system (GPS) · Worldwide Interoperability for microwave access (WiMAX) · Inset · Patch · Defected ground

INTRODUCTION

A single antenna operating in multiple bands is in great demand because it reduces interference, complexity and hardware manufacturing cost. For mass production, flat antennas with thin substrates are high desirable [1]. The slots in the ground plane are called defected ground plane. It is used to reduce the antenna size, excite the additional resonance mode and to reduce surface wave loss [2]. Planar slot antenna is desired because it has low profile, wide impedance bandwidth, suitable to be printed on circuit board and low fabrication cost [3].

The worldwide interoperability for microwave access (WiMAX) standard covers 2.3-2.4 GHz [4], 2.5-2.69 GHz/3.4-3.69 GHz/5.25-5.85 GHz [5]. The WiMAX standard operates at 2.3/2.5/3.5/5.5 GHz.

Various multiband antennas for WiMAX and GPS operation have been proposed. Some of them are Inverted-F antenna for WiFi/WiMAX operation [6], Circular ring with Y shape for WLAN/WiMAX applications, two inverted G-shaped radiators for mobile transceivers [7]; proximity-coupled micros trip antenna for Bluetooth, WiMAX and WLAN application [8], metamaterial monopole antenna for WLAN/WiMAX applications [9], monopole antenna with L and U shaped slots for WLAN/WiMAX Applications [10].

The proposed antenna covers GPS 1.227 GHz and WiMAX 2.5 GHz. The antenna is simulated using ANSYS High Frequency Structural Simulator (HFSS) software which is based on finite element method (FEM).

Antenna Structure: The geometry of proposed antenna is shown in Figure 1. It is designed using FR4 substrate (dielectric constant = 4.4, thickness = 1 mm, loss tangent = 0.02). The proposed antenna is an inset fed patch antenna with parallel rectangular open slots. Slotted ground plane is used to decrease the surface wave loss and to obtain multiband performance. The overall dimensions of the antenna is L×W = 72×60 mm^2. The copper thickness is 0.035 mm. The input impedance at the edge of the patch is very high; so to match the input impedance of the patch with the load impedance; inset feed is used. The width of the 50 ohm microstrip feed is 3 mm [11]. For simplicity square patch is used. The dimension of the patch is 58×58 mm^2.

Table 1: Dimensions of multiband antenna

Ref.	Dimensions (L×W×H) mm^3	GPS (1.227/ 1.575 GHz)	WiMAX
			2.3GHz(2.3-2.4 GHz)
			2.5GHz(2.5-2.7 GHz)
			3.5GHz(3.4-3.69 GHz)
			5.5GHz(5.25-5.85 GHz)
[11]	100×45×0.127	-	3.5
[9]	38×25×1.59	-	2.5/3.5
[10]	30×20×1.6	-	3.5/5.5
[8]	40×30×1.6	-	2.5/3.5/5.5
[7]	60×32×0.8	-	2.6/3.5/5.5
[4]	27×24×0.8	-	3.5
[2]	56×44×0.8	1.575	3.5
[3]	60×100×0.8	-	2.5/3.5/5.5
[5]	45×40×1	-	2.5/3.5/5.5
[6]	15×15×1.6	-	2.5/3.5/5.5
[1]	43.6×18.6×1	1.2/1.5	2.4/2.6/3.5/5.3/5.6
Proposed	72×60×1	1.227	2.5

Corresponding Author: Divya Mathew, Department of ECE, SNS College of Technology, Coimbatore, T. N-641035, India.

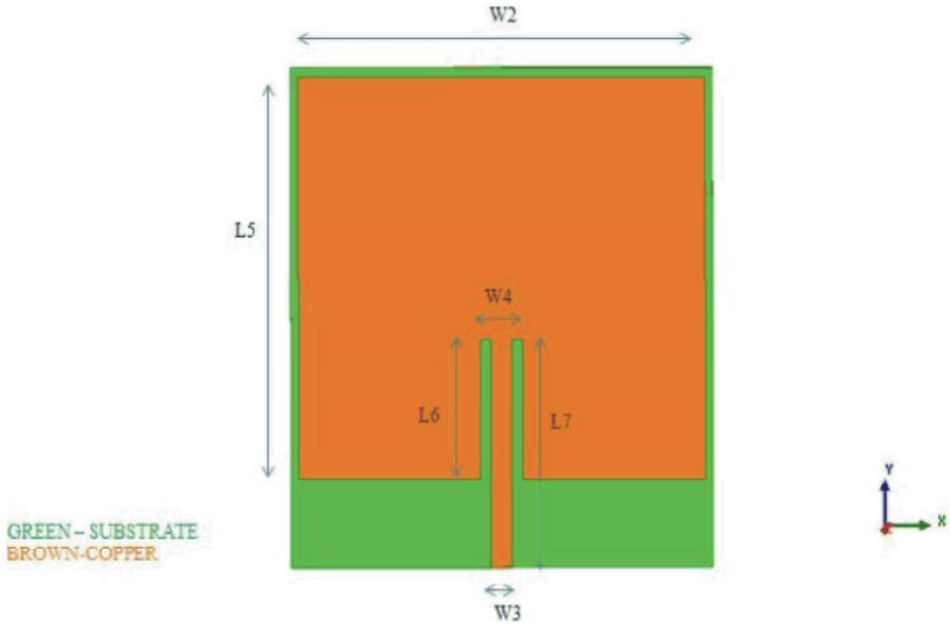


Fig. 1: Front view of inset fed microstrip patch antenna

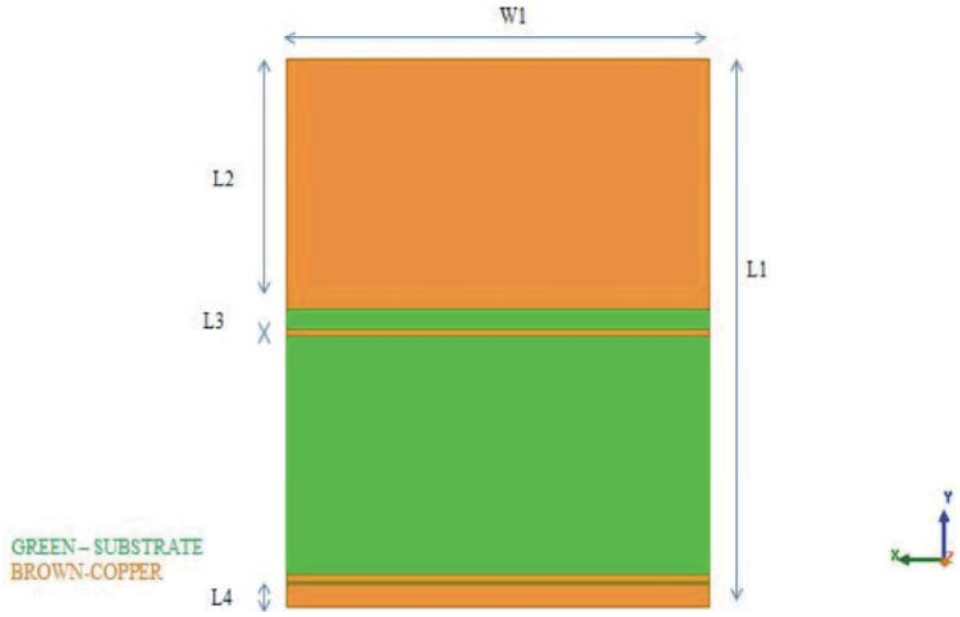


Fig. 2: Back view of the proposed antenna with parallel rectangular open slots

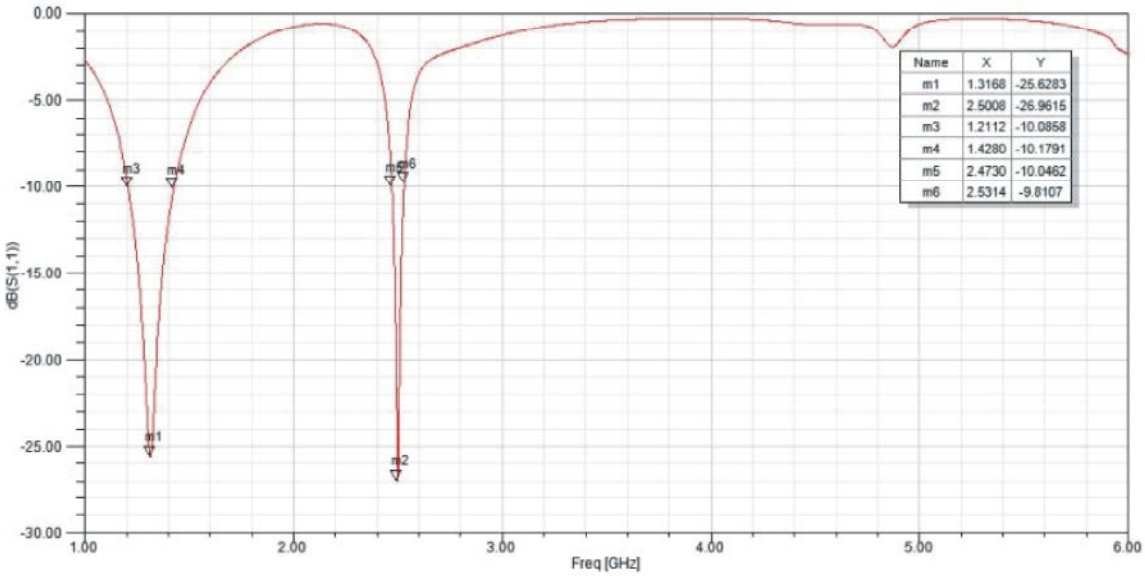
Table 2: Parameters of the proposed antenna

L1	72 mm
L2	33 mm
L3	1 mm
L4	3 mm
L5	58 mm
L6	20.307 mm
L7	33 mm
W1	60 mm
W2	58 mm
W3	3 mm
W4	6 mm

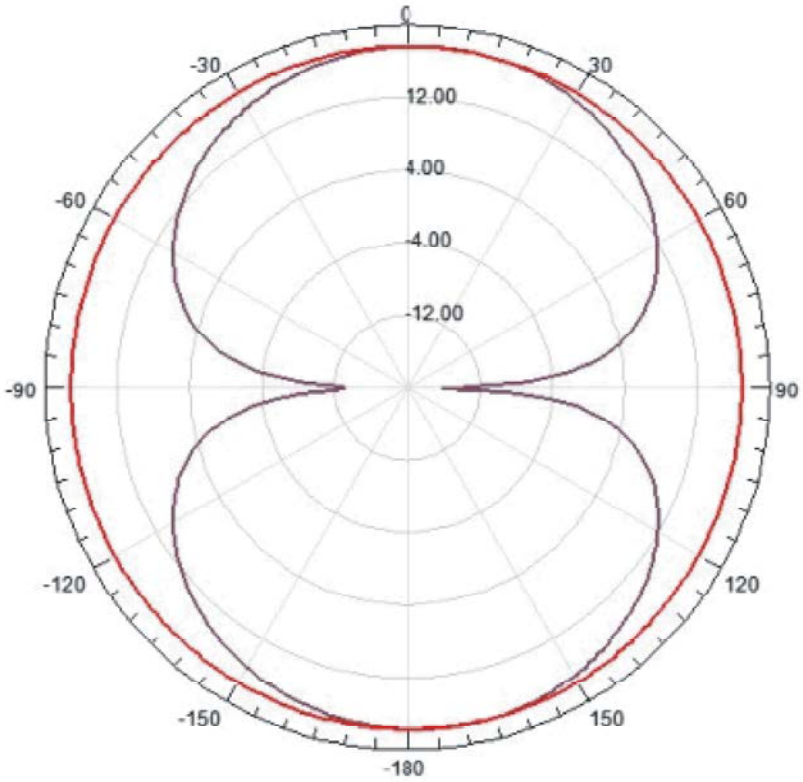
RESULTS AND DISCUSSION

The proposed antenna is simulated using ANSYS High Frequency Structural Simulator Software (HFSS) software which is based on finite element method (FEM). The substrate used for the antenna is FR4 with dielectric constant = 4.4, loss tangent = 0.02 and thickness = 1.6 mm. The overall size of the antenna is L×W = 72×60 mm^2.

Assuming the 10-dB return loss as a reference, the presented results have following bandwidth: 216 MHz (1.21-1.47 GHz) and 242 MHz (2.47-2.53 GHz). The proposed antenna can support 1.227 GHz GPS and 2.5 GHz WiMAX.



The proposed antenna has dipole like radiation pattern. The radiation pattern of E-Plane is like dumbbell and the radiation pattern of H-plane is Omnidirectional. Thus the omnidirectional antenna has low gain. It can be used in those applications where the signals can be received from any direction.



The compact size, simple structure, unidirectional properties and multiband coverage makes the antenna suitable for indoor wireless communication.

CONCLUSION

A multiband antenna for indoor communications has been presented. The structure of the proposed inset fed microstrip patch antenna is simple. Slotted ground planes are used to obtain multiband characteristics. The simulated results have shown that the proposed antenna cover GPS 1.227 GHz and WiMAX 2.5 GHz band. The return loss of both the bands is less than -15 dB. The overall size of the antenna is $72\times60\times1$ mm^3. The proposed multiband antenna has unidirectional properties.

REFERENCES

1. Liu Wen-Chung, Chao-Ming Wu and Yang Dai, 2011. Design of Triple Frequency Microstrip-Fed Monopole Antenna Using Defected Ground Structure, IEEE Transactions on Antennas and Propagation.
2. Pei Jing, An-Guo Wang, Shun Gao and Wen Leng, 2011. Miniaturized Triple-Band Antenna with a Defected Ground Plane for WLAN/WiMAX Applications, IEEE Antennas and Wireless Propagation Letters.
3. Mahdi Moosazadeh and Sergey Kharkovsky, 2014. Compact and Small Planar Monopole Antenna with symmetrical L- and U- shaped slots for WLAN, WiMAX Applications, IEEE Antennas and Wireless Propagation Letters.
4. Lev Pazin, Nikolay Telzhensky and Yehuda Leviatan, 2008. Multiband Flat-Plate Inverted-F antenna for Wi-Fi/WiMAX operation, IEEE Antennas and Wireless Propagation Letters.
5. Dadgarpour Abdolmehdi, Amin Abbosh and Farid Jolani, 2011. Planar Multiband Antenna for Compact Mobile Transceivers, IEEE Antennas and Wireless Propagation Letters.
6. Singh Bakariya Pritam, Santanu Dwari, Manas Sarkar and Mrinal Kanti Mandal, 2015. Proximity-Coupled Microstrip Antenna for Bluetooth, WiMAX and WLAN Applications, IEEE Antennas and Wireless Propagation Letters.
7. He Huang, Ying Liu, Shaoshuai Zhang and Shuxi Gong, 2015. Multiband Met material-Loaded Monopole Antenna for WLAN/WiMAX Applications, IEEE Antennas and Wireless Propagation Letters.
8. Lu Jui-Han and Bing-Jhang Huang, 2013. Planar Compact Slot Antenna with multi-band operation for IEEE 80.16m Application, IEEE Transactions on Antennas and Propagation.
9. Cao Y.F., S.W. Cheung and T.I. Yuk, 2015. A Multiband Slot Antenna for GPS/WiMAX/WLAN system, IEEE Transactions on Antennas and Propagation.
10. Wu Ming-Tien and Ming-Lin Chuang, 2015. Multibroadband Slotted Bow-Tie Monopole Antenna, IEEE Antennas and Wireless Propagation Letters.
11. Wei Mei, Bo Liu and Hong Yi Zhao, 2015. Parallel Rectangular Open Slots Structure in Multiband Printed Antenna Design, IEEE Antennas and Wireless Propagation Letters.