Slotted Plus Shape Microstrip Antenna with enhanced bandwidth

Jagadeesha.S, Vani R.M, P.V. Hunagund

Abstract: In this paper a concept of broadband slotted plus shape microstrip antenna with open end meandering slots in the ground plane is presented. Three identical narrow open end meandering slots were embedded in the antenna ground plane parallel to plus shaped radiating edge and study is made. This antenna is radiating at dual resonant frequencies This covers part of wibro(2300-2390), full band of ISM (2400-2484MHz),Full band of satellite DMB(2605-2655MHz) and overall bandwidth of 474 MHz(19.1%) are achieved. The slotted plus shaped microstrip antenna is simulated using the method of moments based commercial software (IE3D) and was found to perform well in terms of bandwidth and , radiation patterns.

Keywords: Microstrip antenna, multi band antenna. Wide band antenna, Wideband application, slot antenna, plus shaped antenna, Ground plane based antenna

1. Introduction

Rapid progress in wireless communication promises to replace wired communication networks in the near future in which antennas plays a more important role. Microstrip antennas are used in a broad range of applications from communication systems to biomedical system, primarily due to several attractive properties such as light weight, low profile, low production cost, conformability, reproducibility, reliability, and ease in fabrication and integration with solid state devices. One of the most serious disadvantages of microstrip antenna is their limited band width. Researchers investigated method to increase single bandwidth [1-5]. Meandering technique when applied to ground plane of the microstrip antenna was proved to be one of effective method in reducing the size of the microstrip antenna and enhancement of bandwidth[6]. However, the obtained bandwidth in this case is comparatively very less when met with the requirements of the above applications. Further enhancement in the antenna bandwidth and size reduction was very much in need. Many combinations of radiating patch and ground plane slots were configured and analyzed to achieve extreme compact and broad band antennas. T.W Chiou et al [7] introducing slots in the ground plane that helped to enhance bandwidth of a terminal antenna at the upper end of the invested frequency band. Recently broadening of the lower operating frequency band was achieved using two open end slots in the ground plane under the radiating element(inverted F-Typed patch)[8]. It is observed that the use of two parallel open end slots in the ground plane which results in enhanced band width there by generating dual frequencies. In this paper we present slotted plus shape microstrip antenna with open end meandering slots in the ground plane. Three identical narrow open end slots were embedded in the plus shaped antenna ground plane. These slots are aligned with an equal spacing of L/4 parallel to radiating edge.

2. Design Consideration

Plus shaped patch antenna which is considered as base antenna whose two strips of dimensions are considered 15.1mm *45.3mm & 11.8mm*35.4mm respectively is mounted on dielectric substrate of thickness 1.6mm and material used is Glass epoxy with relative dielectric of ε_r=4.4 is designed for operating frequency of 2.2GHz.This rectangular patch in turn fed by center fed microstrip line feed of dimensions(L f50, W f50)=18.4mm,3.05mm through a quarter wave transformer having (Lt50 , Wt50)=18.55mm, 0.5mm) .They are mounted on a ground plane of dimension 82mm*55mm fed by microstrip line using 50 ohm SMA connector for wideband applications is shown in figure 1a. Study has been made further by considering base shape of antenna by inserting horizontal slots on both side with respect to center of patch. Optimized distance between slots is being considered as 2mm which gives lowest frequency but reduced band which is represented in figure 1b. In order to enhance band width later we consider three identical narrow open end slots were embedded in the antenna's ground plane that are aligned with an equal spacing of L/4 parallel to radiating edge of the plus shaped patch.. The embedded open end slots are narrow (Ws=2mm) and have a slot length Ls of about 75% is considered as shown in figure1c. Above antenna gives maximum bandwidth.

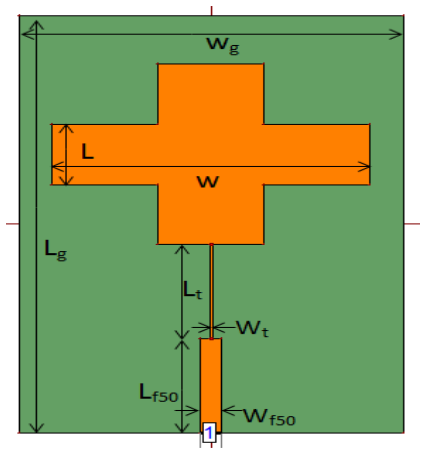

Figure1(a). Plus shaped base antenna

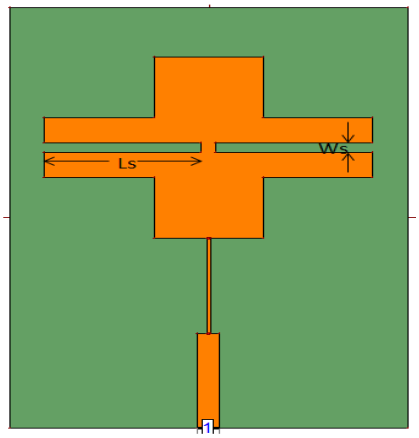

Figure1 (b). Geometry of base Antenna with slot in plus Shaped Patch.

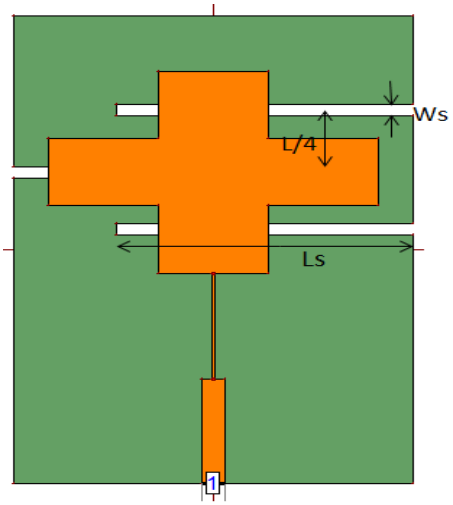

Figure1(c): Geometry of base Antenna with open end Meandering slots in the ground plane

3. Results and Discussions

The proposed Antenna design has been simulated using Zeland's simulation package i.e., IE3D. Comparative study has been made with respect to plus shaped base antenna without having slot in ground plane and by considering optimized slot on plus shape patch with distance between the slot as 2mm which is called Antenna1. It is also being compared with antenna 2 is having slot in ground plane. All the data is summarized in Table 1. Figure 2(a) shows the variation of return loss with frequency for base shape antenna. Variation of Return loss versus frequency for antenna 2 is shown is fig 2 (b). Similarly results for the effect of slot in ground plane is as shown in figure 2(c). From the results it is clear that the bandwidths of proposed antenna with slots in ground plane is more compared to other antennas. The antenna 2 also gives dual bands with overall bandwidth of 474MHz. Radiation patterns for plus shaped base and plus shaped patch antenna with slotted ground plane as shown in fig 3(a) & 3(b) respectively. From the figure3 (a) it is clear that low back lobe radiation is an added advantage for using this antenna in a cellular phone, since it reduces the amount of electromagnetic radiation which travel towards the user head.

Prototype Antenna	Resonant frequency	Return loss	Band width	Over all band width
Plus shaped base antenna	f1=2.2 f2=2.49	-11.63 -11.64	20 100	120
Base antenna with slot(Antenna 1)	f1=2.57	-11	190	190
Base antenna with slot in Ground plane(Antenna2)	f1=2.25 f2=2.61	-21 -26.5	184 290	474

Table1: The Simulated results of Proposed Antennas.

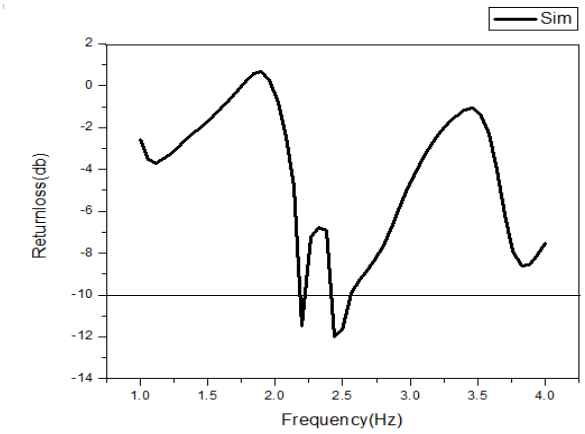

Fig 2a Graph for return loss v/s frequency for base shape

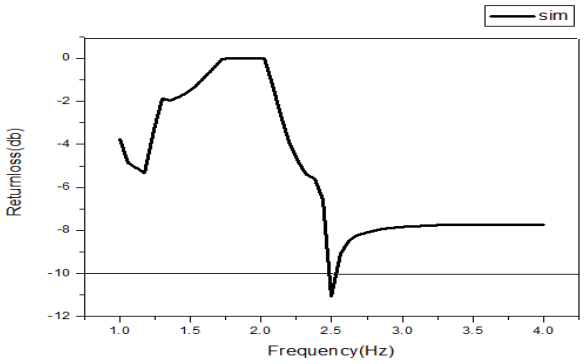

Fig 2b: Graph for return loss v/s frequency for slotted plus antenna.

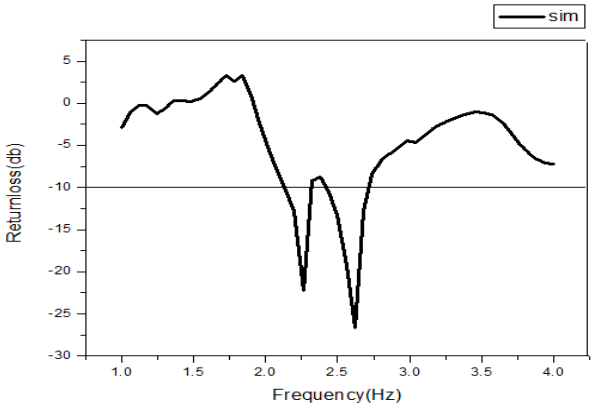

Figure3b: Graph for return loss v/s frequency open end meandering slots in the ground plane of plus shape antenna.

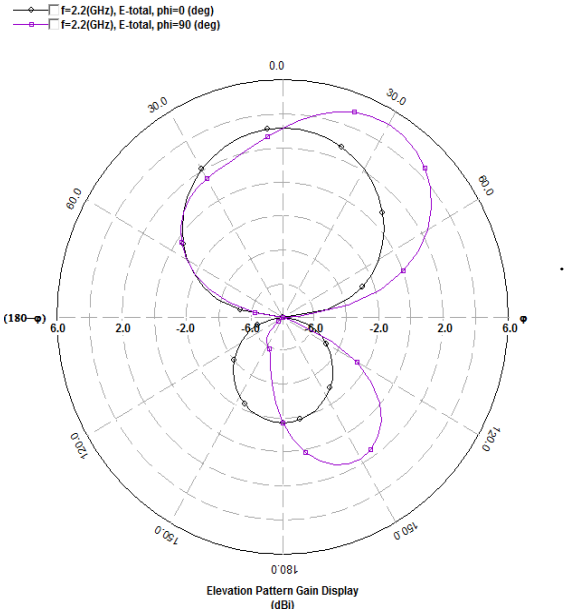

Figure3a: Radiation patterns of plus shaped base at 2.2 GHz.

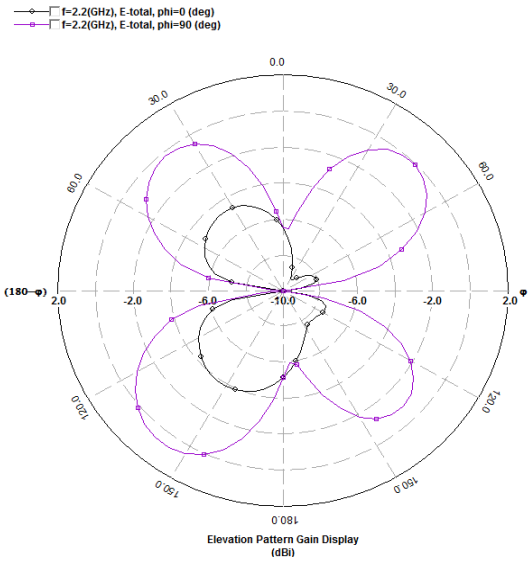

Figure 3b: Radiation pattern of slotted ground plane based plus shaped antenna at 2.25GHz.

4. Conclusion

This paper outlines slotted ground plane based plus shape antenna which gives total band width of 474MHz (19.1%). This bandwidth satisfy the requirements of the many services including part of wibro, full band of ISM and full band of satellite DMB applications. So from the results we conclude that the modified antenna with slots in ground plane gives enhanced bandwidth compared to other configurations.

Acknowledgement

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