U.P.B. Sci. Bull., Series C, Vol. 75, Iss. 4, 2013 ISSN 2286 – 3540

A NEW SLOTTED MINIATURE ANTENNA QUASI-ISOTROPIC COVERAGE

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A novel miniature antenna with quasi-isotropic radiation pattern is presented. The main feature of the proposed antenna is the capability to generate a near isotropic radiation pattern .The design details of the conceived antenna are presented and discussed. Simulations of the different reflection coefficient and radiation pattern are presented. These were carried out using CST Microwave Studio. This model has got numerous applications in network sensors, field measurements and electromagnetic compatibility.

Keywords: Circular polarization, uniform pattern, miniature antenna, microstrip network, near isotropic coverage, slot antenna.

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1. Introduction

The increasing interest for small antenna is the consequence of the development of personal communications and hand help devices such as organizes, computers, navigation tools. For hand help wireless terminals the antenna is a necessary part. However, due to the market and end-user requirements, the antenna should not be visible. The answer to these conflicting requirements is small antennas which can be integrated in the device body [1].

However, the transmitted signal is expected to be as stable as possible, whatever the orientation of the communicating objects. For short distance, low cost, low data rate and low consumption applications, that is to say, when an adaptive solution cannot be envisaged, the most straightforward strategy is to search for an antenna radiating as stable as possible in all directions. Although truly isotropic antennas do not exist[3].

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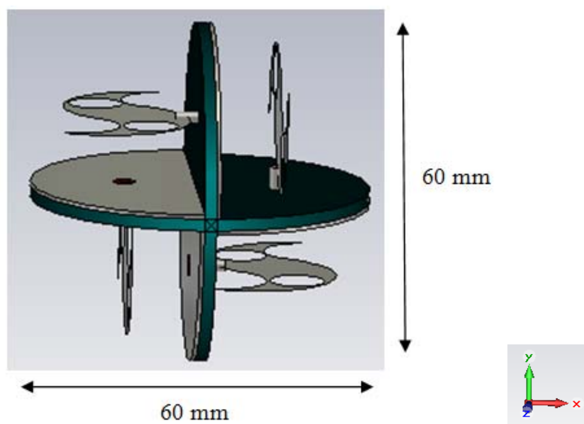
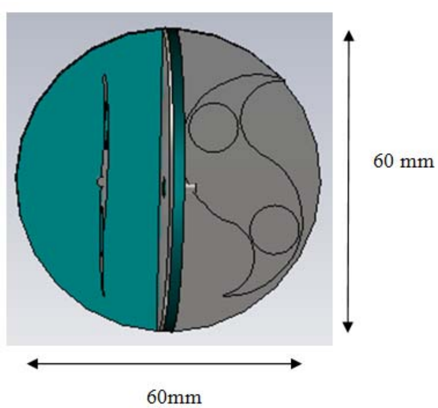
The geometry and detailed dimensions and the feeding network as well as the far-field pattern results of the proposed antenna are successively presented below.

2. Antenna structure

The antenna structure is depicted in Fig1. Four slotted patches are located along the sides of two intersected cylinders. Patches are fed through a ground plane by a *micro-strip* network, etched on the bottom side of the PCB.



(a)



(b)

Fig. 1. (a) Horizontal view, (b) Vertical view of the new antenna model.

Fig 2 illustrates the antenna structure. The green top layer is made of a low permittivity and low-loss substrate, in order to optimize the antenna efficiency and bandwidth, where εr= 2.33, μ = 1 and thickness = 2.1 mm. A 0.7 mm thick copper layer is used as a ground plane for the antenna structure.

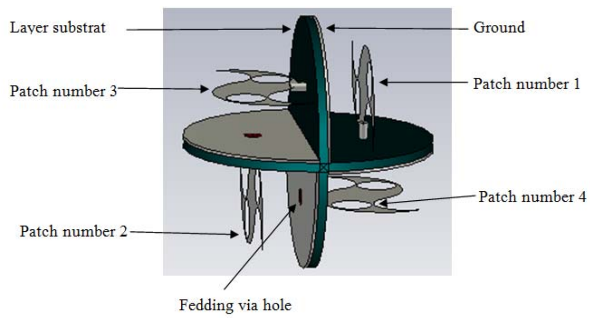
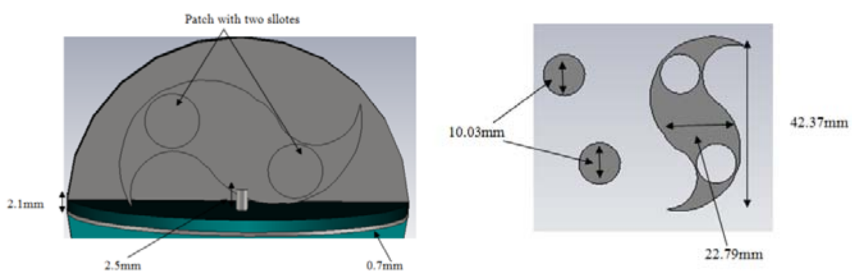


Fig 2. Structure of the *antenna with four slotted patches*

The patch structure of 42.37 mm long and 22.79 mm wide is depicted in Fig3. Two slots of 10.03 mm diameter are located along the each one. This patch is made of copper. They are fed via holes of 1 mm wide and 2.5mm long. Via holes are connected to the feeding network.



(a) (b)

Fig 3 .(a) Layer and arrangement of the patch antenna, (b) First used patch

The four patches are fed with equal amplitudes. S2 and S3 are fed with the same phase of 90°. There is a phase difference of 90° between S1, (S2, S3) and S4. This feeding scheme leads to the targeted particular near isotropic radiation pattern. It presents the advantage of greatly reducing the mutual coupling between patches.

Table1.

Amplitude and phase constraints of the antenna .

Patch number	1	2	3	4
Amplitude relative to patch	1	1	1	1
Phase delay relative to patch	0°	90°	90°	180°

3. Radiation properties of the antenna with first model patch

In Fig4, the computed return loss of antenna with two slots in each patch. The simulated antenna by *CST Microwave Studio* software is well adapted at 2.9 GHz. The reflected power reaches the value of -27 dB.

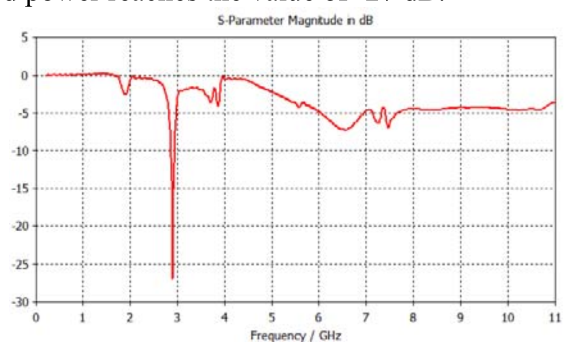


Fig 4. Computed return loss of antenna

The main purpose of the antenna is it's near isotropic radiation pattern which allows the communication performances to be uniform between devices whatever for 2.9 GHz. The antenna radiation pattern is near isotropic. Fig 5 (a) Fig 5(b) and Fig 5(c) present the antenna directivity pattern in two cutting plans at resonant frequency.

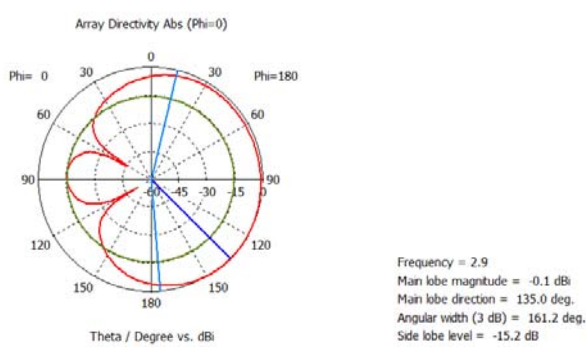


Fig 5(a) . Polar diagrams (Phi=0°) at frequency = 2.9 GHz

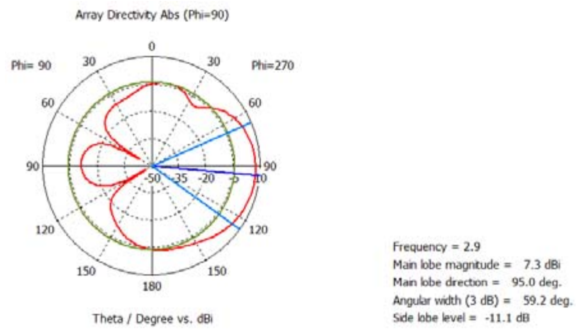


Fig 5(b) . Polar diagrams (Phi=90°) at frequency = 2.9 GHz

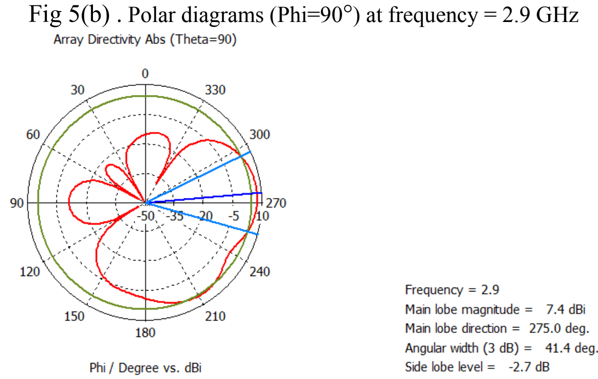
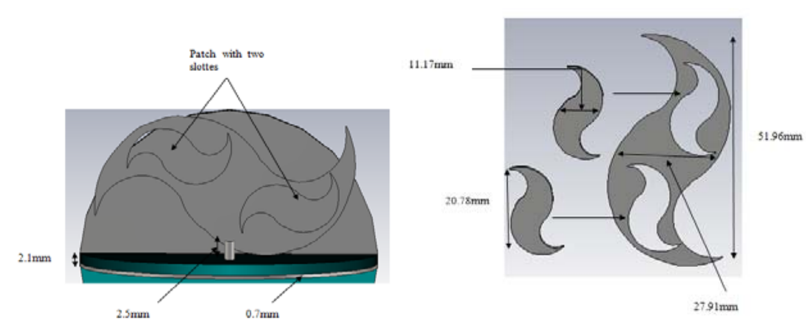


Fig 5(c) . Polar diagrams (Theta=90°) at frequency = 2.9 GHz

Other changes are made on the structure to obtain another dual-band antenna operating at two resonant frequencies. Fig6 illustrates the second proposed patch are 51.96 mm long, 27.91 mm wide .And two slots of 20.78 mm long and 11.17 mm wide.



(a) (b)

Fig 6 .(a) Layer and arrangement of the second patch antenna, (b) second used patch

4. Radiation properties of the antenna with second model patch

In Fig 7, the computed return loss of antenna with two other slots in each patch. At the frequencies of 2.5 GHz, 5.1 GHz, two resonant modes and a good adaptation are observed. The reflected power reaches the values of -22.26 dB, -19 dB at these resonant frequencies respectively.

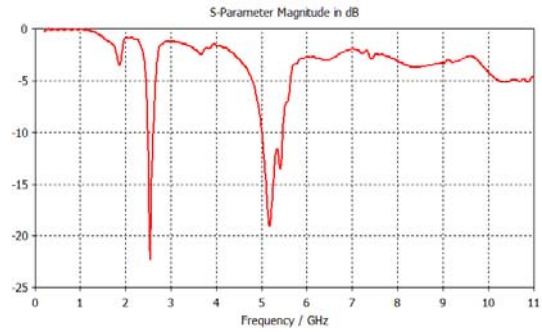


Fig 7. Computed return loss of antenna with second slloted patch.

The radiation patterns of the second slotted antenna are plotted [6] in Fig8(a) to fig8 (f) for two frequencies 2.5 GHz and 5.1 GHz, respectively.They are globally almost isotropic for resonant frequencies.

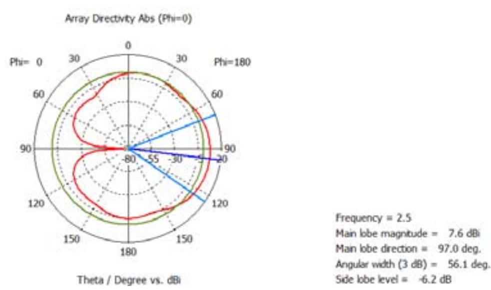


Fig 8(a) . Polar diagrams (Phi=0°) at frequency = 2.5 GHz.

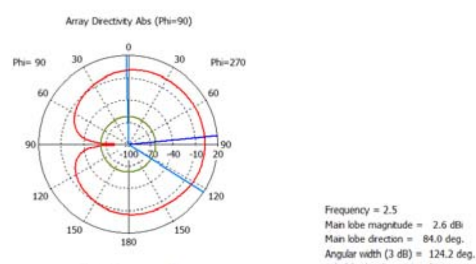


Fig 8(b) . Polar diagrams (Phi=90°) at frequency = 2.5 GHz.

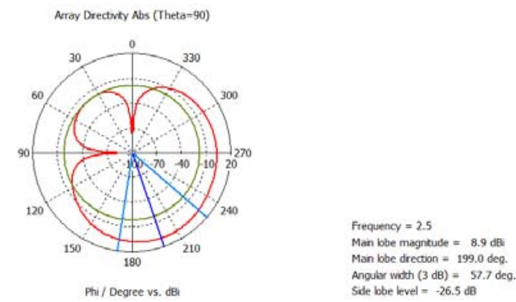


Fig 8(c) . Polar diagrams (Theta=90°) at frequency = 2.5 GHz.

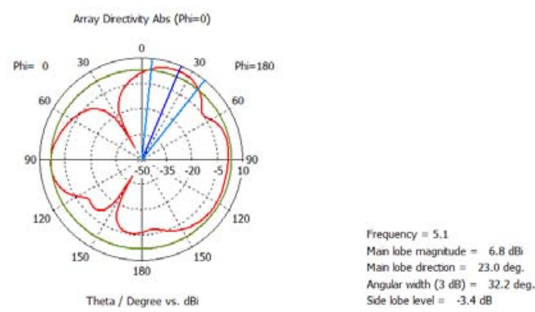


Fig 8(d) . Polar diagrams (Phi=0°) at frequency = 5.1GHz.

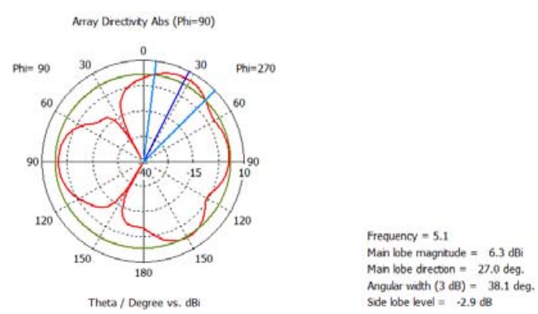


Fig 8(e) . Polar diagrams (Phi=90°) at frequency = 5.1 GHz.

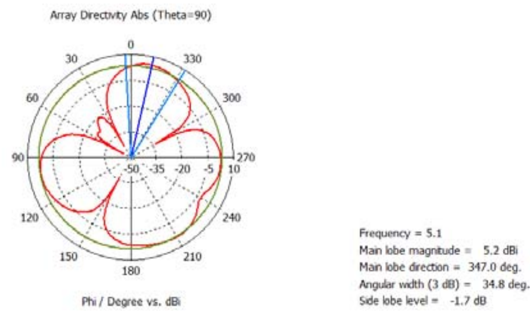


Fig 8(f) . Polar diagrams (Theta=90°) at frequency = 5.1 GHz.

5. Feeding network

The feeding network aims at feeding each Patch with the required amplitudes and phase. A micro-strip network with two 90° hybrid couplers and one 180° hybrid coupler are located in the bottom side of the PCB. The network architecture is shown in Fig 9.

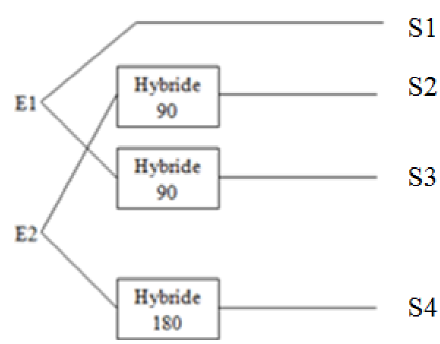


Fig 9. Schematic of the feeding network [4]

The circuit layout, as illustrated in Fig 10, was designed using ISIS Proteus. The components are ultra small SMT. The input network is connected through two U-fl coaxial connectors (E1 and E2).

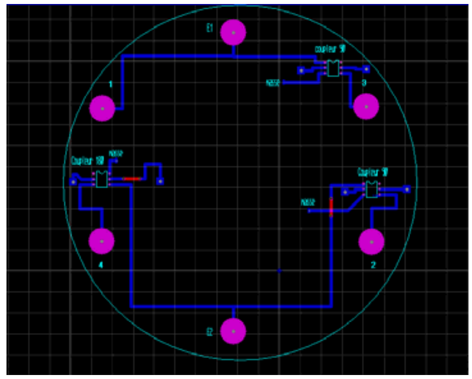


Fig 10. Layout of the microstrip network [5].

The antenna will be positioned in a vertical mode on the PCB.

6. Conclusions

A miniature antenna with two slots on the patches is presented. The simulated results were conducted using the CST Microwave Studio. Furthermore the proposed antenna has a near isotropic pattern in the proposed frequency band signifying that the proposed antenna is suitable for using in field in communications. In addition, key advantage of the proposed antenna is simplicity of designing, simple structure, and cost-effective to manufacture.

R E F E R E N C E S

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