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Gain Enhancement of Clock Shaped Patch Antenna with DGS for WiMAX and X band Applications using Metasurfaces

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Abstract - *A Microstrip-fed wideband antenna with defected ground structure is proposed for WiMAX and X band applications. The proposed antenna uses a Clock shaped radiator which is slotted with hexagonal shape and the ground plane is partial with metasurfaces. The partial ground plane is like EBG Structure and square shaped surfaces are placed on ground for getting greater gain. The proposed antenna with a size of 29x30mm² resonates at 3.45GHz, 8GHz and 10.25GHz with a return loss of more than 18db, VSWR <2, gain of 2.69dBi, 5.26dBi, 5.72dBi and bandwidth of 710MHz, 3.8GHz for X band .The proposed antenna is used for WiMAX and X band applications. The HFSS Software is used for designing the proposed antenna.*

Key Words: Circular Patch Antenna, Hexagonal Slot, DGS, EBS and MetaSurfaces.

1. INTRODUCTION

Now days the wireless communication systems have a great demand for compact design, wideband and low-cost antennas that can operate [1] at various bands. The proposed antenna resonates at WiMAX and X band Applications. The WiMAX Standard range allows from 3.4 to 3.69GHz and X band range [2] is from 8 to 12 GHz. In this design the hexagonal slots are used for getting multiband [3], Defected Ground Structures gives high return loss at operating frequencies and Metasurfaces are used for providing more gain. These Metasurfaces are placed on the ground plane for reflecting the signal back to desired direction. Generally the WiMAX band is generated with a size more than 35x35mm². So In this Compact Antenna is designed with a size of 29x30mm² for multi band response.

The chosen of Substrate material place a major role in the performance [4] analysis of antenna. By selecting proper substrate it will reduce the surface waves and get good results. The maximum power is going to be radiating into free space based on the impedance matching of the feed line. In this design the Strip line feeding is used for reducing the complexity in the fabrication. In this proposal one operating band is achieved Circular patch, Second and Third band with hexagonal slots. Without Metasurfaces the proposed antenna resonates at two bands with low gain. By introducing the Metasurfaces to get average gain of 3dbi. The proposed antenna is designed by using HFSS Software.

2. ANTENNA DESIGN

The design of proposed antenna can be described in four steps. In first step the circular patch antenna is designed on a FR4 Substrate with a thickness of 1.6mm, a dielectric constant of 4.4 and a loss tangent of 0.0009. In this design Strip line feed is used for radiating the maximum power into free space [6]. The second step is cut the patch with hexagonal slot. Third step is ground plane [7] is defected with EBG structure and fourth step is add metasurfaces to ground plane. The proposed antenna with a size of 29x30mm² resonates at 3.45GHz, 8GHz and 10.25GHz.

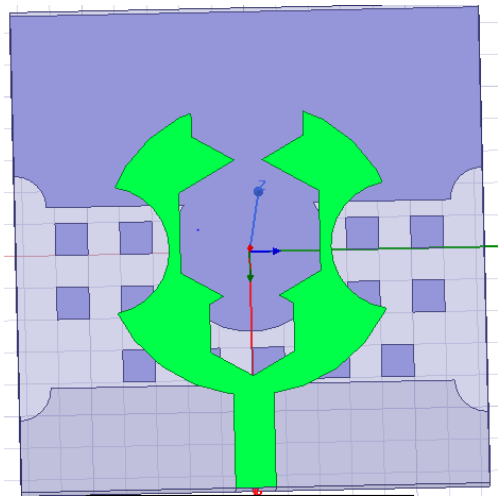

Fig-1: Geometry of Proposed Antenna

The proposed antenna having the ground plane of length and width is 29x30mm², Substrate height is 1.6mm, circular patch radius is 5mm, Hexagonal slot radius is 2mm, strip line width is 2.5mm and Substrate size is also same as ground plane length and width. The lumped port is used for exciting the radiator.

3. RESULTS AND DISCUSSION

The proposed antenna is designed and simulated using high frequency structure simulator [5]. The performance analysis of the antenna is identified for various parameters with respect to operating frequencies. The parameters Return loss, VSWR, Gain and Bandwidth are observed at different

operating frequencies. The proposed [8] antenna resonates at 3.45GHz, 8GHz and 10.25GHz with a return loss of more than 18dB,VSWR<2, with a gain of 2.69dBi, 5.26dBi and 5.72dBi and a bandwidth of 710MHz for WiMAX, 3.8GHz for X band.

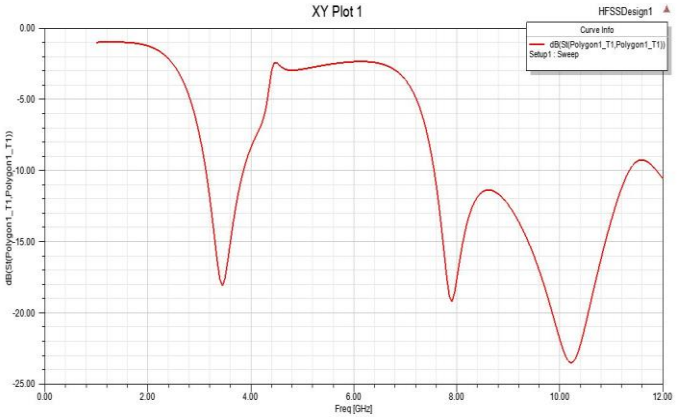

Fig-2: Retutn loss variation with Frequency

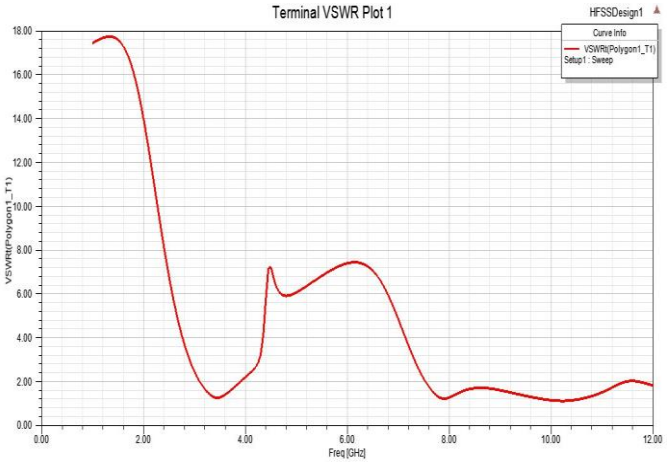

Fig-3: VSWR variation with Frequency

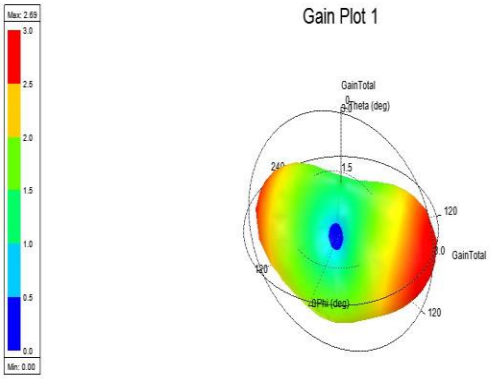

Fig-4: Radiation pattern at 3.45GHz

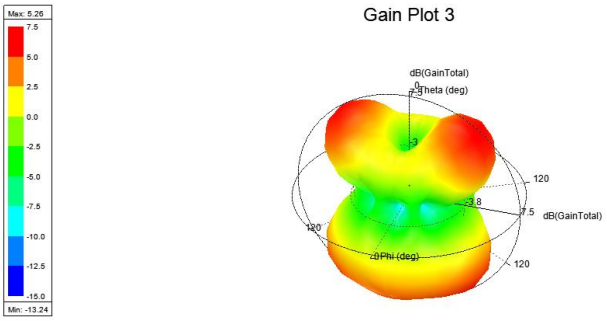

Fig-5: Radiation pattern at 8GHz

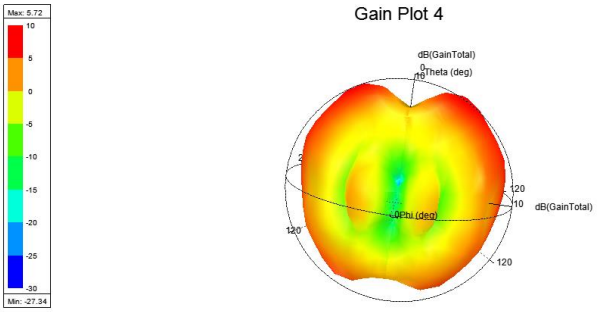

Fig-6: Radiation pattern at 10.25GHz

The results of proposed antenna can be summarized and shown in Table 1.

Table-1: Antenna performance parameters

Resonant Frequency	3.45GHz	8GHz	10.25GHz
S11(dB)	-18	-19	-23.5
VSWR	1.2	1.2	1.2
Gain(dBi)	2.69	5.26	5.72
Bandwidth	710MHz	3.8GHz	3.8gHz

3. CONCLUSION

In this paper A Compact clock shaped patch antenna is designed for WiMAX and X band Applications. The new techniques are introduced for getting multiband, wide band and more gain. The proposed antenna resonates at 3.45GHz, 8GHz and 10.25GHz with return loss more than -18db, VSWR less than 2 and an average gain of more than 3dBi.

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