

# 2\*4 Circular & 2\*2 Rectangular Microstrip Patch Antenna Array of 4.2GHz for Satellite Applications

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## ABSTRACT

Circular micro strip patch antenna array is designed at a frequency of 4.2 GHz. In this paper we are comparing 2x2 rectangular array and 2x4 circular array antenna with 1x4 circular array. 2x4 circular array achieves more gain and better radiation pattern and return loss. This band of frequencies more suitable for satellite applications.

**Keywords:** Circular patch antenna array, rectangular array.

## Introduction

Recent trend of applications are performed most efficient way in wireless scenario. Single antenna achieves somewhat lesser gain but using an array increases the gain, efficiency and radiation pattern. Compared to 1x2 and 1x4 circular patch antenna arrays 1x4 circular array performs better operation. Properties of antenna design can change towards the applications. Stable antennas should have maximum gain and constant radiation mechanism and improve band of frequencies. Circular micro strip patch antenna arrays are most suitable for different wireless applications. Improvement in gain and bandwidth is achieved by inserting slots, stubs on patch antenna.

Circular micro strip patch antenna array resonate at an array of 1\*2 and 1\*4 array are used to increase the gain. The resonator is to be operating at 2.45GHz by using HFSS software. Copper and graphene based materials are used to fabricate for these array antennas. These graphene based materials mostly worked at ISM( Industrial Scientific Medical Radio band) applications[1]Circular patch antenna is performed more by introducing shorting pins; these pins are lead to operate at high frequency ranges. This antenna is resonating at 5.8GHz. Gain performance is improved by using short pins compared to circular patch antenna array without pins[2]The circular polarization of aperture coupled antenna array of micro strip feed line was operated at 5.5GHz for cube satellite applications. Part of the satellite family is called cubesat. The structure of four patch antenna array to be placed on cubesat in addition with solar panels[3].To improve

the radiation with less attenuation, graphene based material is used for patch antenna array[4]

Nowadays most of the emerging technology is 5th generation (5G), these technologies are resonate at 28GHz with a design of 2\*2 air substrate patch antenna array.[5]Folding antenna array also to be used for circularly polarized micro strip patch antenna with an array of 2\*2 arrays. It is fabricated and measured at a frequency range of 3GHz[[6].Different slot antennas are used to enhance the gain. Jui-han proposes an L shaped slot within the circular patch antenna array. This L shaped strip performs two band of frequency ranges, low band of frequency can extend up to 7 to 12.5% as well as higher band of frequency can extend up to 18.9% to 21.5%.[7] 4\*4 Circular patch antenna array performances suitable for gigabyte range of communication, i.e. 81 to 86 GHz (E band) range. SIW (substrate Integrated Waveguide) is used to enhance the antenna array efficiency. These high range of frequencies mostly suitable for GB point to point wireless services, which exhibits 90.3% radiation efficiency [8]

Another approach for transmitting the signals with circular polarization is transmit array antenna in addition with aperture coupled patch which is in the range of K band which is suitable for satellite applications.[9]Nowadays cognitive radio applications are most popular to enhance the efficiency and frequency band.12 port MIMO antenna is one of the UWB (ultra wide band) antenna. These 12 ports frequency ranges resonate from 3Ghz to 11GHz.[10]Saeed Ur Rehman proposed an other than conventional material i.e. metamaterial

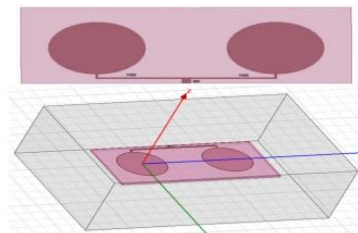
frequency selective surface(FSS),metamaterial was designed for two approaches one is Electro magnetic Absorber and other one is beam radiator.unit cell is the main part of metamaterial. if unit cells are used in repeated pattern i.e periodic structure of unit cell, this can achieve high gain, more efficiency etc.[11]

**Structure Of Antenna Design**

Micro strip patch antenna consists of ground, substrate and patch. Here we are using coaxial feeding technique. In the existing system, we have observed that micro strip patch antenna using patch

elements having array size of 1\*2 and 1\*4 in the frequency range of 2.4GHZ. For an antenna array of size 1\*2 which is in the frequency range of 2.4GHZ, the obtained values for different parameters are given below.

- Gain = 6db
- Directivity = 14.6db
- VSWR = 1.7
- Return loss = -11.6db
- Radiation = 50%

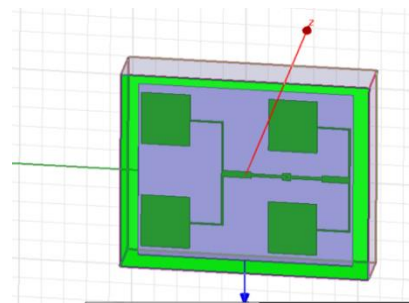


**Fig.1: Design of 1x2 circular patch antenna array for 2.4GHz applications**

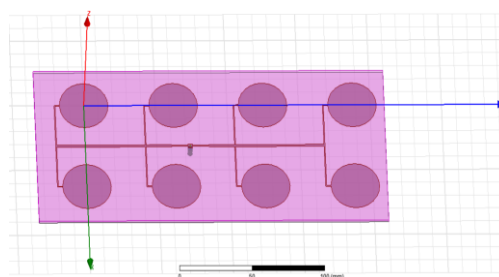
**2x2 rectangular and 2x4 circular array Antenna**

In order to reduce the drawbacks of the existing system, we are proposing for the design of another microstrip patch antenna. The proposed antenna will

be operating in the frequency range of 4.2GHZ, and the antenna array size of 2\*2 rectangular and 2\*4 circular array antenna.



**Fig.2: Design of 2x2 rectangular patch antenna array For 4.2GHz applications**



**Fig.3: Design of 2x4 circular patch antenna array For 4.2GHz applications**

**comparison between 1x2 circular with 2x2 rectangular and 2x4 circular arrays.**

Design of circular patch antenna array consists of ground, substrate and circular patch antenna. RTDuriod5008 material is used for the substrate

material and its thickness h=1.6mm. To simulate this antenna design was used ANSYS HFSS software. The radiation pattern is obtained by giving coaxial feeding at the center of the patch.

**Table 1: Comparison between 1x2, 2x2 and 2x4 array**

S.No	Parameters	Existing System 2.4GHz	Proposed System 4.2GHz	Proposed method 4.2GHz
1	Return Loss	-11.6dB	-26dB	-26dB
2	VSWR	1.7	1.1	1.1
3		6dB	1.3dB	8dB
4	Type	1X4 Circular	2X2 Rectangular	2X4 Circular

**Circular Patch Antenna Array**

2x2 rectangular array and 2x4 circular arrays both are resonating at frequencies of 2.4GHz and 4.2 GHz band of frequencies. In coaxial feeding technique, radius of coaxial cable is 1.6mm, radius of Pin is 0.35mm and radius of probe is 0.7mm, and also circular patch antenna radius is 17mm. Ground and substrate dimensions are 115.7mm X 244.2mm. The power divides in array in the range of 2<sup>n</sup>. The distance between circular patch and parallel lines must be properly decide to reduce the mutual coupling. For proper feeding network one  $\lambda_g/4$  and 2nd  $\lambda_g/4$  should be connected to the microwave

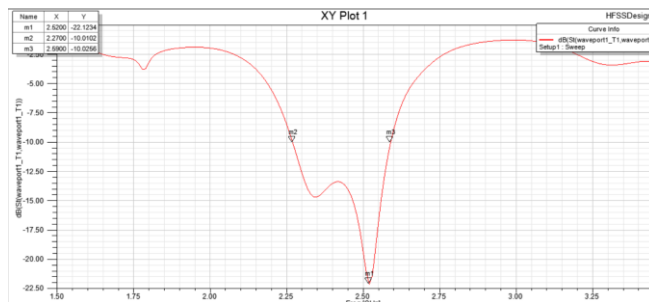
transmission line section. Altering the location of the circular patches in the 1x2 array, it was shifted to wider side direction. Double 1X2 arrays could form the 1X4 array, similarly double 2X2 arrays could form the 2X4 arrays.

In two array representations, d must be greater than guided wavelength.

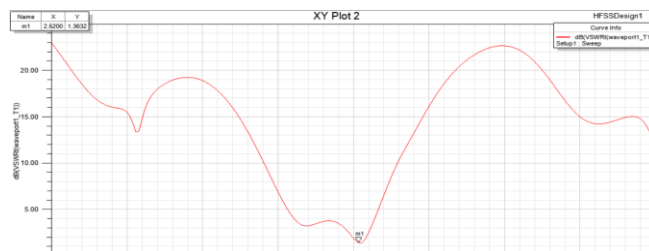
**Results**

2X4 circular patch antenna array performs better return loss i.e. obtained return loss -26db and VSWR is 1.1. Maximum amount of gain (8dB) was achieved by using this 2X4 array.

**Results of 2X2 Rectangular patch antenna array**



**Fig.4: Return Loss for 2X2 rectangular array**



**Fig.5: VSWR for 2X2 rectangular array**



**Fig.6: Gain for 2X2 rectangular array**

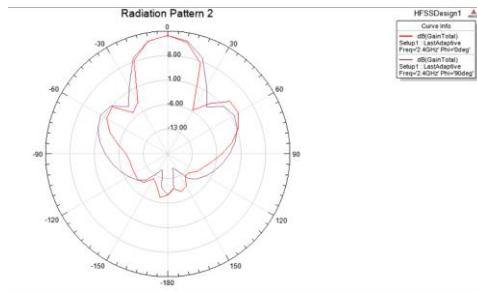


Fig.7: Radiation pattern for 2X2 rectangular array

Results of 2X4 Circular patch antenna array

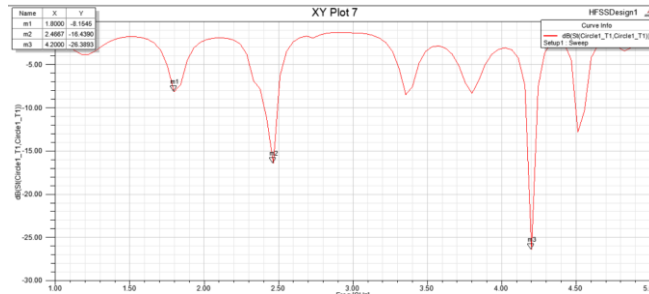


Fig.8: Return Loss for 2X4 Circular patch antenna

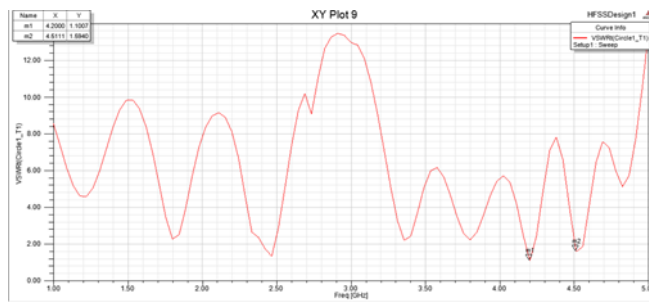


Fig.9: VSWR for 2X4 Circular patch antenna

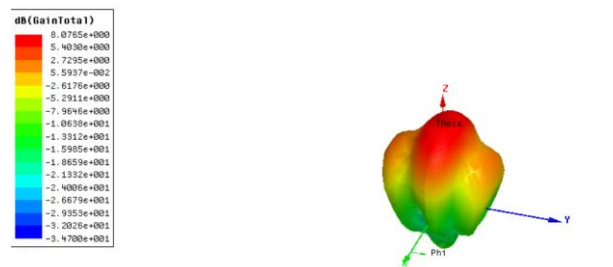


Fig.10: Gain for 2X4 Circular patch antenna

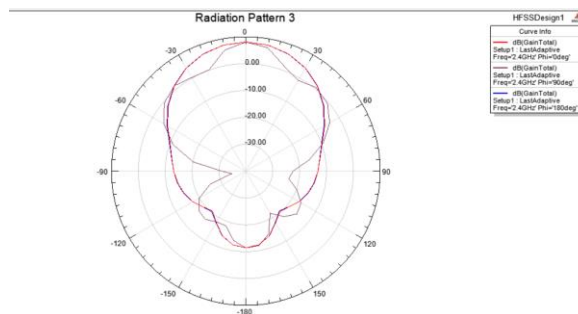


Fig.11: Radiation Pattern for 2X4 Circular patch antenna

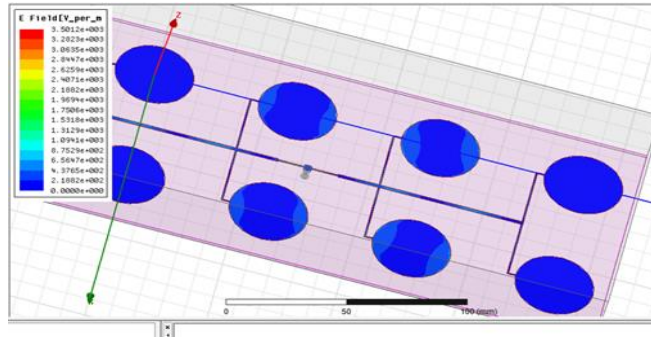


Fig.12: E Field Vector for 2X4 Circular patch antenna

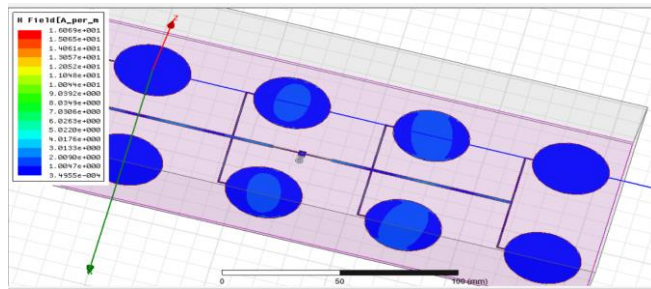


Fig. 13: H Field Vector for 2X4 Circular patch antenna

#### Applications

- Satellite communication for downlink bandwidth speed.
- Weather forecasting system.
- It is present in c band and used in telecommunications via satellite.
- 5G technology.
- Space research.

#### Conclusion

Array antenna contains number of individual radiators; this performs better results like more gain, radiation pattern and better return loss rather than conventional antenna. The proposed method exhibits enhanced gain in the range of 8db and obtained return loss is -26db

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