ISSN: 2248-9622 www.ijera.com Vol. 2, Issue5, September- October 2012, pp.2124-2127

# Design Of Single & 1x1 Microstrip Rectangular Patch Antenna Array Operating At 2.4 GHz Using ADS

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## ABSTRACT

**This article describes the design of single microstrip rectangular patch antenna and 1x1 microstrip rectangular patch antenna arrays operating at 2.4 GHz. Simulation result shows that 5.199 dB and 7.84 dB gain can achieved at frequency 2.4 GHz. Also simulation result show that the return loss is 18.809 at 2.360 GHz in 1x1 microstrip antenna array and current distribution and 3D radiation pattern ,2D cut out radiation pattern in phi- plane in both single and 1x1 microstrip antenna array .The method of this design ,electromagnetism simulation software ADS-2008 plays an important role. These antennas have designed using momentum simulation method of ADS-2008.This work focuses on designing, measuring and testing an antenna to capture electromagnetic energy from the RF signals that have been radiated by communication and broadcasting system at ISM band 2.4GHz and Momentum Simulation method in ADS-2008 has been used for design antenna array**

**Keywords – Microstrip antenna, ADS-2008**

## I. INTRODUCTION

A microstrip antenna has radiating patch on one side of a dielectric substrate, which on the other side has a ground plane. The patch conductors usually made of copper or gold can be virtually assumed to be of any shape. However, conventional shapes are normally used to simplify analysis and performance prediction. The radiating elements and the feed lines are usually photo etched on the dielectric substrate.. In case of the power from ambient RF sources the amount of captured energy is extremely low. So a single patch antenna does not sufficient to increase the power level. So an antenna is essential for increase the power label. In the lower frequency bands antenna gain is very poor because at low frequencies, electromagnetic wavelengths are very high, on the order of several miles sometimes, and much longer than the dimensions of the antennas .Antenna gain is directly proportional to antenna size relative to wavelength. Hence, antenna gain at these frequencies is very low [3].So microstrip rectangular antenna array is designed. The antenna array is the concept in which similar antenna elements are oriented similarly to improve the directivity in particular direction.

The momentum simulation method in ADS2008 has been used for design antenna array. Momentum is best on the numerical discretization techniques is called the method of moments. This techniques is used to solve the Maxwell's electromagnetic equation for planer structure in a multilayered dielectric.

## II. METARIALS & METHOD

The dielectric material that is used in this design of the Microstrip Patch Antenna is R04003C from Rogers corps with $\varepsilon_r$ = 3.5. The selection of substrate depends on the type of circuit, operating frequency of operation and the amount of dissipation from the circuit. The properties of substrate materials should be high dielectric constant, low dissipation factor, high purity high resistivity, high stability, surface smoothness and thermal conductivity[3].The size of the antenna array is depend on the dielectric constant..

The bandwidth is directly proportional to the substrate thickness or height and directly proportional to the $\varepsilon_r$ The conductor and dielectric loss is more important for thinner substrate and conductor loss increase with the frequency due to skin effect.

The parameter that are decided by the default in order to continue to the design process are -

Dielectric substrate $\varepsilon_r$ = 3.5
Velocity of light=3x$10^8$ m/s
Loss tangent=0.002
Operating frequency (f) =2.4GHz
Conductivity=5.8x$10^7$(copper)
Height of substrate (h) =1.52 mm
Thickness of ground plane=35μm
Feeding method=-microstrip line (inset feed)
Polarization = linear
Name of Substrate metal=R04003C
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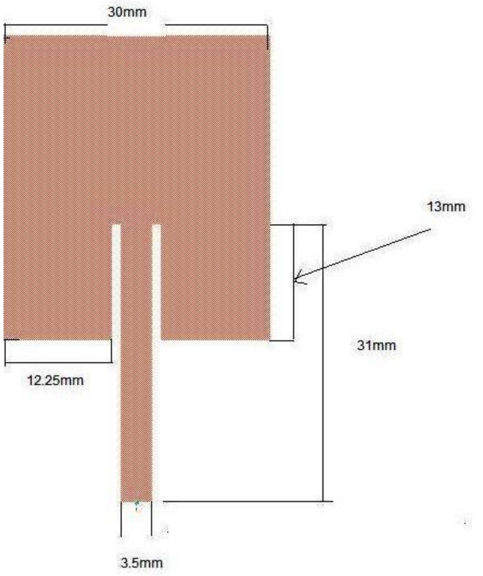


Fig1.Single microstrip rectangular patch antenna

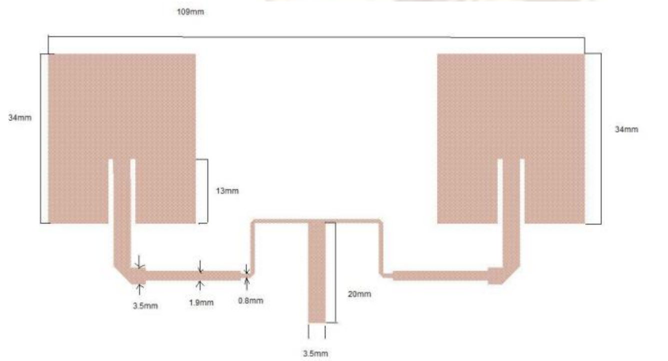

Fig2. 1x1 microstrip recctangular patch antenna array

### III. RESULT AND DISCUSSION

The 1x1 microstrip patch antenna array antenna array are simulated using Momentum Simulation method of ADS-2008. The return loss of the 1x1 microstrip patch antenna is 18.809 dB when resonance frequency is 2.360 GHz. The gains of single microstrip antenna and 1x1 antenna array are 5.199 dB and 7.84 dB and the directivity of and single microstrip antenna and 1x1 antenna array are 6.84dB are 9.00dB and

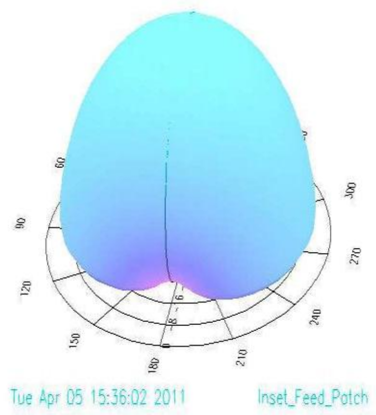


Fig3.3D radiation pattern of microstrip single patch antenna

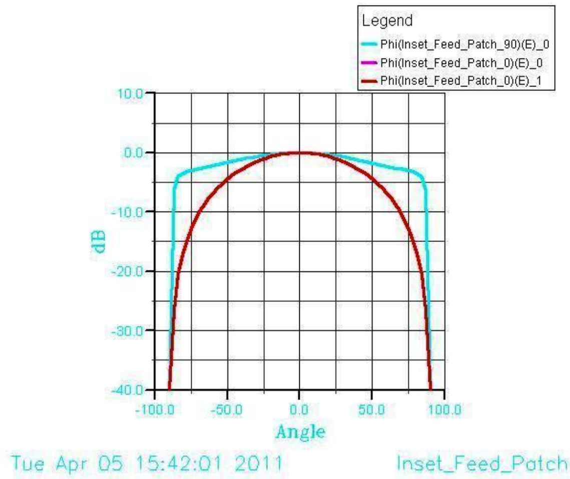


Fig4. 2D Cut out radiation pattern in phi-plane of single microstrip patch Antenna

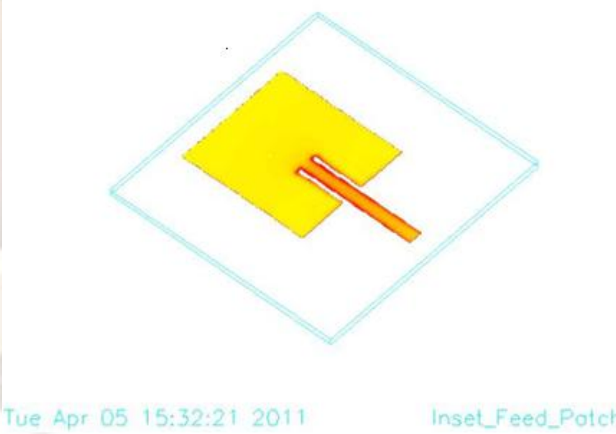


Fig5. Current distribution of microstrip single microstrip rectangular patch antenna

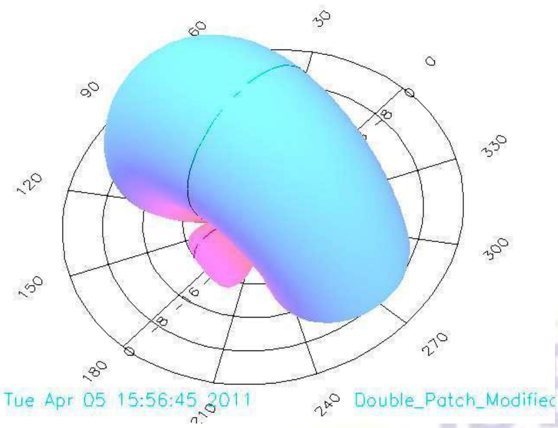


Fig6.3D radiation pattern of 1x1 microstrip rectangular patch antenna array

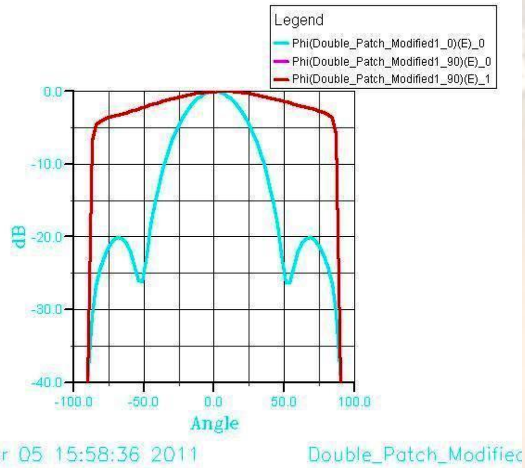


Fig7. 2D Cut out radiation pattern in phi-plane of 1x1 microstrip rectangular antenna array

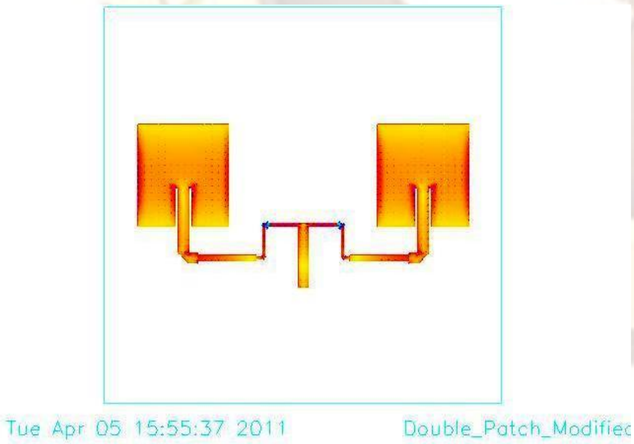


Fig8. Current distribution of 1x1 microstrip rectangular patch antenna array

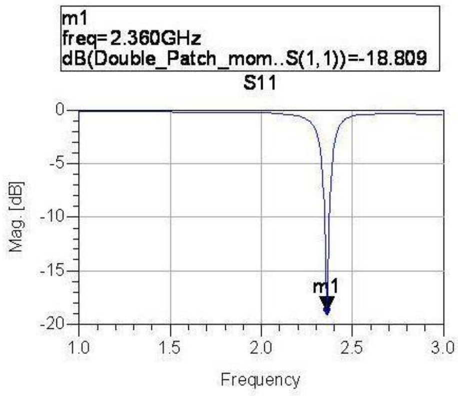


Fig9. Return loss curve of 1x1 microstrip rectangular patch antenna array

Table1. Simulated result of single microstrip rectangular parch antenna and 1x1 microstrip rectangular antenna array

| **Parameter** | **Single Antenna** | **1x1 Antenna Array** |
|---|---|---|
| Power radiated(Watts) | 0.006240205734 | 0.00752353892 |
| Effective Angle(degree) | 161.92 | 90.53 |
| Directivity(dB) | 6.480203762 | 9.005617351 |
| Gain(dB) | 5.1997419719 | 7.848334812 |
| Maximum Intensity(Watts/Steradian) | 0.002208052628 | 0.004761831714 |
| Angle of U Max (theta ,phi) | 0.00 | 6.00 |
| E(theta)Max(mag, phase) | $6.4492588e^{-006}$ | 1.894142709 |
| E(phi) Max (mag, phase | 1.289837567 | 0.008752616206 |
| E(x)Max (mag, phase) | $6.449242588e^{-006}$ | 0.008752616206 |
| E(y)Max(mag ,phase) | 1.289837567 | 1.883766397 |
| E(z)Max(mag, phase) | 0 | 0.1979918266 |

## IV. Conclusion

The aim of this thesis to design single and 1x1 microstrip antenna array and to study the 3D radiation pattern, current distribution and 2D cut out radiation pattern and also study the return loss of 1x1 microstrip antenna.

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## Acknowledgements

I would like to express my gratitude and heartiest thanks to my guide Mr. Santu Kumar Giri for his inspiration , encouragement & guidance to complete this thesis. I would like to thank my parents Md. Salauddin & Mahilara Begum for their unending love and support to complete this thesis.

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