A Naval Analysis of Microstrip Antenna Array using Various Elements for ISM-Band

Chaitanya Bethala, K Manjunathchari

Abstract: Right now, point is to contrast single fix receiving patch and 1x2 exhibit and 1x4 radio patch on FR4. The emphasis will be on upgrading the elements of fix reception apparatus additionally kept up a high increase in the ISM band (2.3 GHz to 2.6 GHz) at focus recurrence 2.45 GHz. Various parameters of reception apparatus like VSWR, return loss, increase gain and radiation design are reproduced utilizing Ansoft HFSS programming v13. Microstrip patch radio wire in remote correspondence is picking up significance as a most impressive mechanical pattern. Its enormous potential guarantees huge change in close to term eventual fate of remote application fields. The current innovative pattern has concentrated on microstrip patch radio wire. Single microstrip patch reception apparatus has a few favorable circumstances (ease, lightweight, conformal and low profile), however, it has little detriments too-like low addition, low productivity, low directivity, and thin data transfer capacity. These weaknesses can be overwhelmed by the execution of many fix reception apparatuses in a cluster design. Here term exhibit represents geometrical and electrical courses of action of fix components. As we increment the number of patch components to frame a cluster, improvement in execution is watched. Right now, for 1x1, 1x2, 1x4 clusters have been investigated and thought about. It has been inferred that the 1x4 patch cluster shows a preferable outcome over a single patch.

Keywords: Micro-patch, array elements, 1x2 and 1x4 clusters, gain, return loss.

I. INTRODUCTION

ISM implies Industrial, Scientific and Medical recurrence band. This is a band of radio and microwave frequencies grouped around 2.4GHz, saved and assigned for modern, logical and clinical hardware that utilization RF. Modern gear like MRI machines, testing hardware, and some radio telescopes utilize this ISM band of frequencies. Simple consumer equipment, for example, microwaves, carport entryway framework, codeless telephone, remote switch and remote mouse are likewise intended to run at frequencies around 2.4 GHz.

Most media transmission equipment work at a much lower recurrence than 2.4GHz. Having different gadgets work at just a specific recurrence run, right now, decreases obstruction with the media transmission frequencies. This implies utilizing a remote switch and a mobile phone at the time will have no obstruction with one another.

Comprising of a dielectric substrate sandwiched in the middle of a ground plane and a fix. The idea of the Microstrip reception apparatus was first proposed in 1953, twenty years before the viable radio wires were delivered [1-2]. Since the principal down to earth reception apparatuses were created in the mid-1970s. A portion of the primary edges of the microstrip reception apparatuses is that it has lesser manufacture cost, its little weight, less volume, and low profile arrangements that it very well may be made conformal, it tends to be effectively be mounted on rockets, rockets, and satellites without significant alterations with the ever-expanding requirement for versatile correspondence and the rise of numerous frameworks, it is essential to plan broadband radio wires to cover a wide recurrence extend [3-5]. The plan of a productive wide band little size radio wire, for ongoing remote applications, is a troublesome errand. Microstrippatch radio wires have discovered broad application in remote correspondence framework attributable to their preferences, for example, low profile, similarity; ease creation and simplicity of combination with feed systems [4-6]. Be that as it may, these receiving wires are commonly manufactured on thicker substrates. The addition of a solitary fix radio wire is additionally expanded by expanding the no of cluster components. Each cluster component improves the increase of a radio wire. The proposed single fix, 1x2 patch and 1x4 [8-10] patch are planned and look at their changed parameter. It has been reasoned that a 1x4 exhibit shows preferred execution over a single fix receiving wire. Different exhibits improve the addition of a radio wire just as the data transmission of the receiving wire.

II. DESIGN ANALYSIS:

There are a few sorts of investigation model accessible for microstrippatch radio wire transmission mechanism, cavity mechanism, and full wave mechanism (which incorporate essential fundamental conditions/minuscule technique) in which transmission mechanism is most simple, direct technique and having great physical perceptive [11-13].

2.1 Transmission mechanism

In the communication method, the microstrippatch antenna having the edges at the ends of the antenna, it has L and W. These having different substrate material and different dielectric values in the applicable medium.
Along these lines, most by far of the field lines exist in the substrate material and some parts of specific lines noticeable all around which is showed up in figure 1. Subsequently, this transmission mechanism can’t support the unmodified Transverse electromagnetic (TEM) technique for transmission, in light of the fact that the stage paces would be particularly recognizable substrate material. Instead of the overwhelming strategy for spread, it would be the quasi-TEM. An amazing dielectric consistent (ε_{reff}) must be accomplished for the flanking and the wave spread in the line. The approximation of ε_{reff} is not actually ε in light of the fact that the flanking fields at the edge of the patch are not limited in the dielectric substrate material however then again, are transmitted perceptible all around as showed up in figure above.

\[ \Delta L = \text{fringing length} \]
\[ = 0.421h \left( \frac{\left( \frac{\varepsilon_{reff} + 0.301}{\varepsilon_r^w + 0.264} \right)^{\frac{1}{2}}}{\left( \frac{\varepsilon_{reff} - 0.2580}{\varepsilon_r^w - 0.80} \right)^{\frac{1}{2}}} \right) \]

Where ε_{reff}is the Effective dielectric constant
\[ L = L_{eff} - 2\Delta L \]

L_{eff} = 2*L
W_{eff} = 2*w

\[ f_1 = \frac{6h}{2} \]
\[ W_f = \frac{f_1}{2} \]

\[ f_1 = 10^{-4}(0.001699 * \varepsilon_r^2 + 0.13761 * \varepsilon_r^6 - 6.1783 * \varepsilon_r^5 + 93187 * \varepsilon_r^6 - 682.69 * \varepsilon_r^5) \]

**Table 1: Antenna Dimension**

| Parameters | Values (mm) |
|------------|-------------|
| W          | 38          |
| L          | 29          |
| Substrate thickness | 1.6       |
| Substrate  | FR4         |

### 2.2 Antenna Feeding Methods

In microstrip patch antenna having four major types of feeding mechanisms are available, like coaxial coupling, aperture feeding, microstrip line coupling and proximity coupling. The paper present the microstrip line feeding method used.

### III. ANTENNA STRUCTURAL DESIGN AND SIMULATE RESULTS

#### 3.1. Single Rectangular Patch Antenna

The conservative rectangular microstrip patch of 38*29mm ispositioned on the dielectric substrate material of 50*50*1.6 cube mm have dielectric constant of fixed value is 4.4. Projected structure is shown in figure 3. In this paper focus on strip line coupling method is used. For proper impedance toning between patch and strip line of 3mm width, feed line of 13.29 mm is used.
B. Two Component Patch Antenna

For increasing the gain, two quadrangular slots of 38*29 mm are used in the conventional patch. Figure 6 displays the geometrical construction of two element patch antenna.

Figure 6: Geometrical construction of two element Patch antenna

The software simulated S11 return loss conjunction to the frequency is displays in figure 7. Here observing that resonant frequency is increased and bandwidth is increased. The antenna is having 4.08% bandwidth at 2.45 GHz resonant frequency.

C. Four Element Patch Antenna

For enhancing the gain and four element arrays are used. Figure 10 displays the geometrical construction of four element patch antenna.

Figure 10: Geometrical construction of four element Patch antenna

In this, the S11 conjunction to the frequency, which is available in figure 11, it is noticed that the antenna is resonated at 2.48 GHz frequency. The calculated impedance bandwidth is 4.43%.
D. Comparative Analysis of Gain:

By measuring the antenna performance gain is also an important asset of the antenna. The below table displays the comparative analysis of the antenna parameter.

**Table2: Comparative analysis of simulated results of return loss parameter**

| Arrangement         | Bandwidth (%) | Resonant frequency (GHz) | Gain in dB | Return loss (dB) |
|---------------------|---------------|--------------------------|------------|------------------|
| Single patch antenna| 4.5           | 2.335                    | 0.66       | -17.274          |
| 1x2 patch array antenna | 4.08       | 2.45                     | 4.17       | -19.65           |
| 1x4 patch antenna    | 4.43          | 2.48                     | 5.79       | -34.49           |

E. Fabricated Antennas

![Figure 13: Single patch& two element array](image)

**Figure 13: Single patch & two element array**

**IV. CONCLUSION**

Right now, is contemplated, planned and reproduced three parts of a micro strip patch transmitting and receiving wire. The first is the rectangular patch, second is a two-component exhibit and the third is four-component clusters by utilizing High-frequency structure test system. There is a critical upgrade in the increase in four-component exhibits in contrast with two-component and single Rectangular fix reception apparatus.

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AUTHOR PROFILE

Mr. Chaitanya Bethala, Assistant Professor, Department of Electrical, Electronics & Communication Engineering, GITAM School of Technology, Hyderabad Campus, completed in M. Tech (Microwave Engineering). Presently, he is working as Assistant professor in Electrical and Electronics Engineering Department, School of Technology, GITAM (Deemed to be University) Hyderabad, Telangana.

Dr. K. Manjunathachari received his Ph. D from JNT University, Kakinada. He is having 18 years teaching experience and 3 years of Industry experience. At present Dr. K. Manjunatha Chari is working as Professor & HOD, Department of Electrical, Electronics & Communication Engineering, School of Technology, GITAM (Deemed to be University), Hyderabad, Telangana. He has published more than 50 research articles in reputed journals.