4X1 linearly polarized rectangular patch array antenna for Wireless applications

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***Abstract* — The optimum scenario of this paper is to design and analyze the results of 4X1 rectangular patch array antenna with a single feed at an operating frequency of 5.5 GHz on an FR4 substrate. The primary methodology used to design the proposed antenna was to simulate using HFSS software. The results of proposed antenna has been determined in terms of antenna parameters such as gain, return Loss, VSWR, impedance matching, bandwidth, directivity and radiation pattern. It was found that the simulated antenna yielded 403 MHz of band width with a tolerable amount of return loss.**

***Index Terms*—Micro strip patch antenna, FR4, vector network analyzer**

I. Design of 4X1 Rectangular Patch Antenna

The fundamental principle of array antenna is based on the radiation characteristics. Hence we first implemented the single patch antenna which has the dimension of **32.03779mmX32.197mm** [1] from that we extended the work for 4X1 array antenna to increase the parameter of gain. The proposed array antenna consist of the design specification [2] of

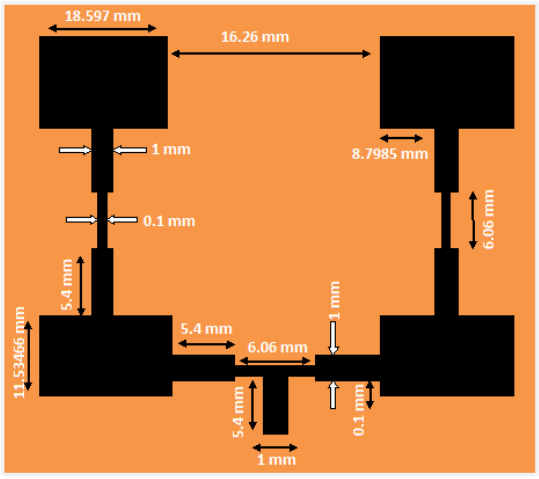
a. Operating frequency ,fo = 5.5GHz
b. Height of the substrate , h =1.66mm
c. Dielectric constant FR4, Ɛr=4.4

The overall dimension of the array antenna is **61.33245mmX65.454mm**.Hence it is portable to use it for wireless applications. The following formulas [3] are used to design the proposed array antenna

$$w = \frac{c}{2 f_c \sqrt{\frac{(\varepsilon_r + 1)}{2}}} \quad (1)$$

$$\varepsilon_{reff} = \frac{(\varepsilon_r + 1)}{2} + \frac{(\varepsilon_r - 1)}{2}\left[1 + 12\frac{h}{w}\right]^{-\frac{1}{2}} \quad (2)$$

$$\Delta L = 0.412h\frac{(\varepsilon_{reff} + 0.3)\left(\frac{w}{h} + 0.264\right)}{(\varepsilon_{reff} - 0.258)\left(\frac{w}{h} + 0.813\right)} \quad (3)$$



$$L_{eff} = \frac{c}{2 f_c \sqrt{\varepsilon_{reff}}} \quad (4)$$

Fig: 1. Geometry of 4X1 rectangular micro strip patch array antenna

II. Results and Discussion

The results of the designed antenna were mainly focused on increasing the gain parameter. The gain of 9.58dB and directivity of 12.2dB with half power beam width (HPBW) of approximately 48 degrees with low side lobe levels had achieved for 4X1 array antenna [4]. The 50Ω impedance is also matched at a designed frequency [5]. The distance between the two patches is $\lambda/4$ which has been used as a T-junction and transmission line between the two patches for to design the array antenna [6]. A heuristic approach was made to find the strip line width. The following figures show the simulated results of return loss, VSWR, radiation pattern [7].

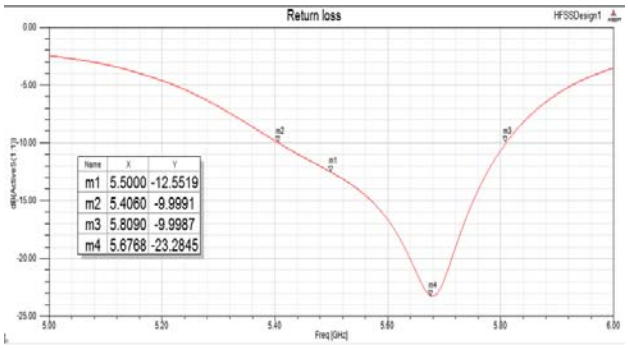


Fig 2. Simulated return loss of 4X1 rectangular micro strip patch array antenna

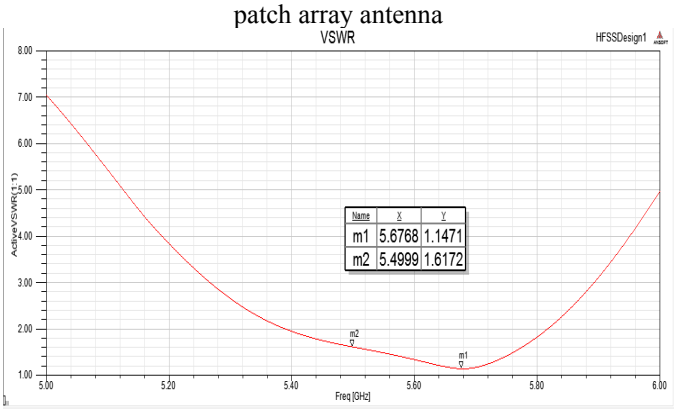


Fig 3. Simulated VSWR of 4X1 rectangular micro strip patch array antenna

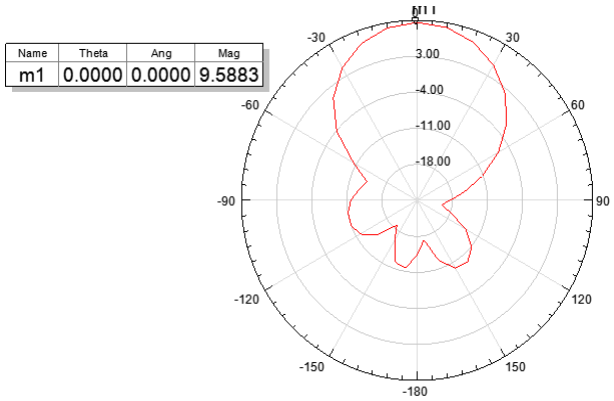


Fig 4. Simulated radiation pattern of 4X1 rectangular micro strip patch array antenna

III. Conclusion

The proposed antenna has achieved the return loss of -12.5519dB at 5.5GHz and -23.2845dB at 5.6768GHz. The VSWR of designed antenna shows the result of 1.6172 at 5.5GHz and 1.1471 at 5.6768GHz respectively. However there is a shift of maximum results occurring at the operating frequency of 5.6768GHz. This error can be rectified at the fabrication process. 403 MHz bandwidth was achieved for the proposed 4X1 array antenna varying from 5.4060GHz to 5.8090GHz. The bandwidth percentage will be 7.45% and 6.93% respectively. The cross-polarization between E and H plane of the designed 4X1 array antenna shows the maximum difference of 27.12dB.

III. REFERENCE

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