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# Wideband Yagi Uda antenna for X-band Applications

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**Abstract -** *The paper presents a patch antenna design for wideband operation in X band. The proposed antenna is achieved using unequal resonance arms fed by Coplanar Waveguide (CPW). This design has three unequal unequal arms fed by CPW to Slotline through a T-shaped slotline transition produce three resonances to broaden the impedance bandwidth. The 1x2 patch array cover frequency ranges (S11¬<-10dB) from 8.55 to 11.8 GHz. The proposed antenna has resonance tuning ability, enhanced impedance bandwidth with uni directional radiation pattern.*

***Key Words***: E shape, Unequal Arms, Wideband, X-band, Yagi uda

## 1. INTRODUCTION

Microstrip antenna for satellite communication has become very considerable due to their feature s such as low profile, light weight and ease of fabrication. But the low gain and narrow impedance bandwidth of these structures are a challenge for researchers. Various designs have been made to enhance bandwidth of microstrip antenna. They include utilizing a thick substrate [1] and cutting the slots in the radiating element. The example of cutting slot s comprise E-shaped printed antenna [2], which provide wide bandwidths for wireless operations. By implementing a CPW- fed slot antenna with L-shape monopole 11[4], the impedance bandwidths are further enhanced. CPW feeding compared with the microstrip feedline, indicates lower radiation losses, less dispersion and ease of integration with active devices. As reported in [6], the printed slot antenna with a CPW to slotline transition feed is introduced for improving its impedance and radiation performance. Printed antenna arrays are widely used in telecommunication and radar systems. There are many kinds of microstrip antenna arrays reported in several literature for wideband operations [7]-[9].In this paper a wideband 1x2 patch antenna arrays fed by CPW to slotline with the T shaped slots on the ground plane .the proposed array designs, unequal arms based on CPW feeding line and a couple of slotline transitions produce three adjacent resonance with the measure -10dB impedance bandwidth of 9.1, 10.3 and11.3GHz

## 2. ANTENNA DESIGN AND PERFORMANCE

The geometry of the proposed 1x2 patch array is shown in Fig.1. This antenna has two radiating patches with three unequal arms which through FR4 substrate connect to the ground plane with the slotline section

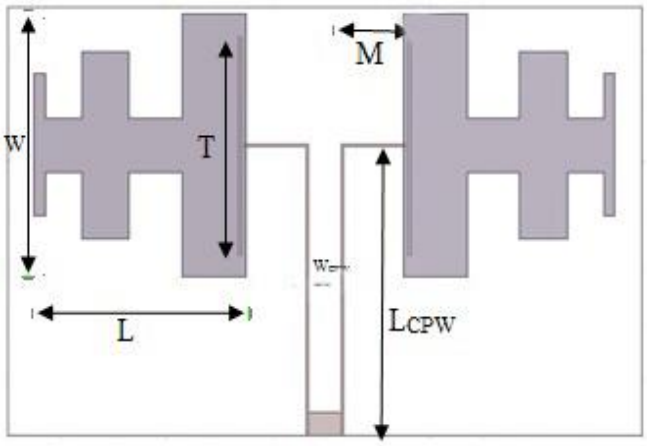



**Fig -1**: Geometry of proposed antenna (Top View)

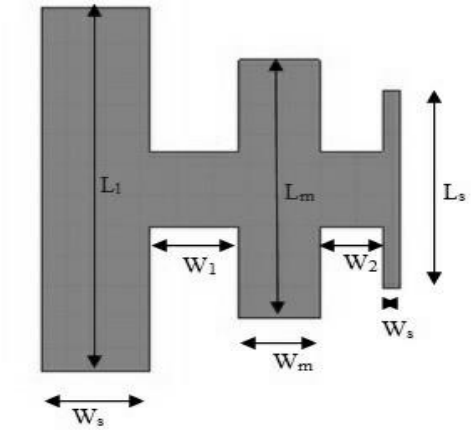



**Fig -2**: Patch dimension

The ground plane has dimension of 60mm x 39mm. Patches are fed by CPW, which excite by slots on the opposite side of substrate. The thickness and relative permittivity of FR4 substrate are h=1.6mm and εr =4.4mm respectively. The width of strip and slot of CPW are 3 and 0.3mm. Width of slotline is 0.3mm. The CPW feed is located in the center of the structure in the X-axis. Length of CPW in 26.25mm. The asymmetric patches with three resonance arms are aligned in the transverse direction of the CPW. Moreover, T-shaped slotlines with the length of T, which are placed at the distance of M from feedline have an impressive effect on achieving a wide impedance bandwidth. The design of proposed antenna array is made on the basis of an E-shaped patch with unequal arms to attain multiple resonances [10]. The slot length, width and position on an e-shaped patch with multi-arms

have a prominent role in achieving a broad bandwidth. The proposed patch design is similar to two asymmetric E-shaped patches which are connected together back to back. The dimensions of the proposed arrays are as follows: W=24, L=20, T=20, M=6.5, Ll=24mm, Lm=17mm, Ls=13mm, Wl=6mm, Wm=4.5mm, Ws=1mm, W1=5mm, W2=6mm, Lcpw=26.25mm, Wcpw=3mm.

## 2.SIMULATION AND EXPERIMENTAL RESULTS

The simulation results are made using Ansoft High Frequency Structure Simulator (HFSS). With the finite element method. Chart 3, the reflection coefficient of patch array show the array has a simulated frequency range of 8.55 to11.8 GHz for S11 <-10dB. It includes the wide bandwidth of almost 3GHz in X-band.

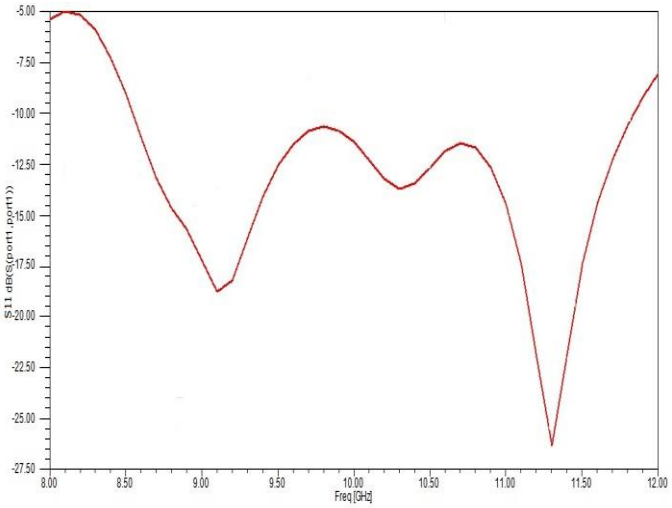
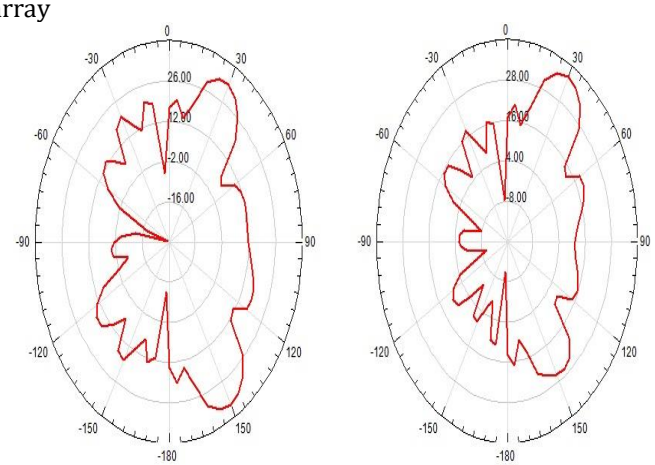



**Chart -3**: Simulated Reflection coefficient of proposed patch array




xz-plane(φ=0) yz-plane (φ=90)

**Chart -4**: Normalized radiation patterns of co and cross-polarization at 9.5 GHz for 1×2 patch array

The measured and simulated radiation patterns in the xz-plane (H-plane) and yz-plane (E-plane) at 10.3GHz. The cross-polarization level in the E-plane is higher than that in the H-plane. This is mainly because of the feed location on the x-axis. The proposed structure possesses inherent asymmetry which generates higher order modes and consequently produces cross-polarized radiation. A comparison with previous works is done in Table 1. The proposed design indicates better performance compared with other wideband.

**Table -1:** Performance comparison of the proposed antenna array with previous researches.

| Proposed array designs | Total size of antenna ( length × width × total height ) | Total size of antenna (length× width×total height ) |
|---|---|---|
| U-slot patch antenna array in [7] | 75×75×3.5 $mm^3$ | 5.65-6.78 GHz |
| Circularly polarized patch array in [8] | 75×75×1.5 $mm^3$ | 5.20-6.23 GHz |
| Proposed 1×2 array design | 60×39×1.6 $mm^3$ | 8.55-11.8 GHz |

## 3. CONCLUSION

The three resonance arms of 1x2 patch arrays which are fed by CPW line with a combination of two similar slotline transitions include -10dB impedance bandwidth of 9.1,10.3,11.3GHZ for wideband operation in X-band

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