

Design and Development of Wideband Patch Arrays using Disparate Arms in K-Band for Satellite Communication

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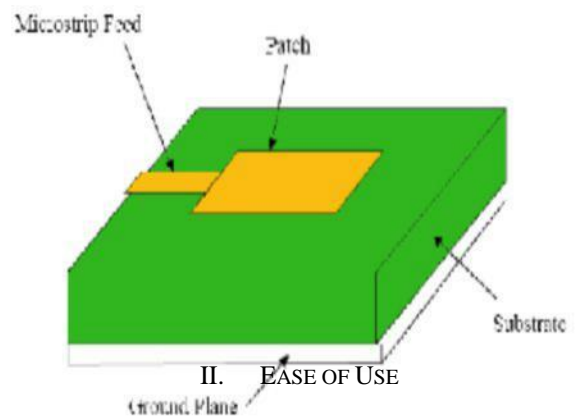
Abstract— This paper presents a wideband patch antenna array in k-band for wideband operation. The proposed patch arrays are designed by using disparate resonance arms fed by coplanar waveguide. This proposed antenna covers the frequency ranges ($S_{11} \leq -10$ dB) from 15 to 35 GHz. The main purpose of designing the proposed antenna to enhance the impedance bandwidth. By varying the length of the disparate arms, To broadening the impedance bandwidth. Coplanar waveguide (CPW) feed is introduced for improving its impedance bandwidth and radiation performance. The proposed antenna arrays have some features such as resonance tuning ability, low-fabrication cost and enhanced bandwidth. This antenna is simulated using HFSS and fabricated, tested for S-parameters and the performances is used for wideband applications. The proposed antenna mainly used for satellite communication.

Keywords— Antenna Arrays, Coplanar Waveguide(CPW), Micro strip Antenna.)

I. INTRODUCTION

MAJOR hurdle in the micro strip patch antenna array design is its limited band width. The substrate-integrated waveguide (SIW) technology is used to design a cavity- backed micro strip patch antenna array at low cost multilayer printed circuit board process and Co-axial feed line is used **in this antenna** . However, at low frequencies where the radiation performance tends to poor due to strong mutual coupling between separated elements[1], The patch array covers offer as a lower profile and light weight matching structure [2]. Asymmetric coplanar waveguide(ACPW) series feed network is used to design a 2×2 rotated patch antenna array [3]. The implementation of 2×2 patch array Using polystrata process [4]. The large array are the main issue limiting its efficiency and application e.g., T/R modules and phase shifter [5]. They enhance the isolation in micro strip patch antenna array. The resonant frequency of the two patch antennas Coupled along H-plane at a frequency 4.8 GHz [6]. The 2×2 micro strip line fed U-Rectangular antenna implemented by place the feeding network and patch array in same layer. It give frequency range from 5.65 GHz to 6.78 GHz [7]. They provide a advantage of mutual coupling between array element, Then cost of antenna is decreased [5]. It improve the isolation by 16 dB [6]. They design the wide band micro strip patch antenna for ultra wide band applications. It achieved by using folded-patch feed's technique [8]. The 2×2 patch array is implemented by using sequential-phase feeding network. Both axial ratio and impedance bandwidth is enhanced and wider than previous

published sequential -fed single layer patch arrays [9]. The patch antenna are used to generate millimeter-wave hermite-gaussian beam at E-band [10].



II. ANTENNA DESIGN AND PERFORMANCE

The geometry of the proposed 1×2 patch array is used. This antenna is composed of two radiating patches with three disparate resonance arms resonance which made up of FR4 substrate with the dimensions of $80 \times 50 \text{ mm}^2$. Patches are fed by the CPW, which excite by slot line transitions with the T-shape slots on the opposite side of the substrate. The thickness and relative permittivity of FR4 substrate are chosen to be $h=1.6$ mm and 2.2 respectively connect to the ground plane with slot line sections. Both total width and length patches are 24mm, which are printed on the ground plane.

A. Side View

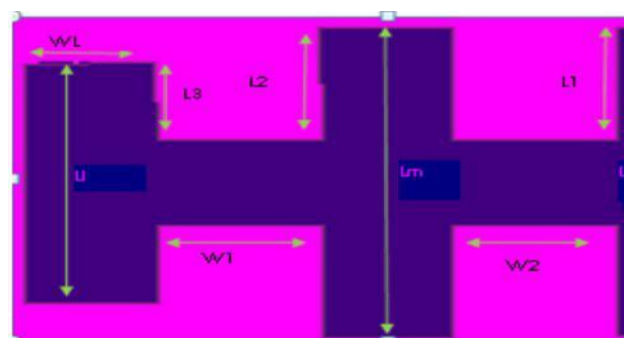


Fig 1: Side view design

Table 1: Parameters Of Unequal ARMs

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W	24mm	L	24mm	Lcpw	26.25mm
W1	6mm	L1	24mm	Wcpw	3mm
Wm	4mm	Lm	18mm	T1	20mm
Ws	4mm	Ls	14mm	T2	11mm
W1	5mm	L1	9.5mm	T3	3.2mm
W2	5mm	L2	6.5mm	S	80mm×50mm
M	6.5mm	L3	4.5mm	h	1.6mm

B. TOP VIEW

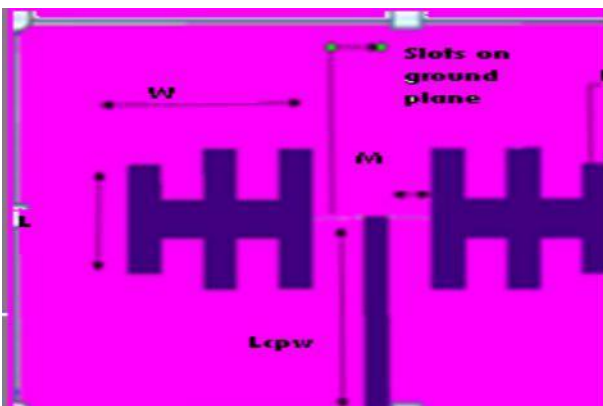


Fig 2: Top View Design

C. CURRENT DISTRIBUTION

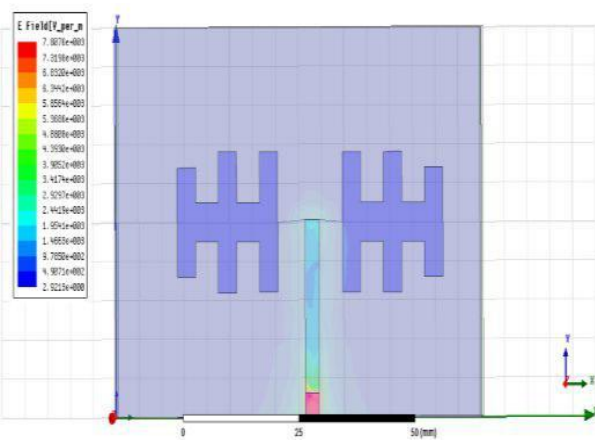


Fig 3: Current Distribution Design

III. SIMULATION AND EXPERIMENTAL RESULTS

A. RETURN LOSS

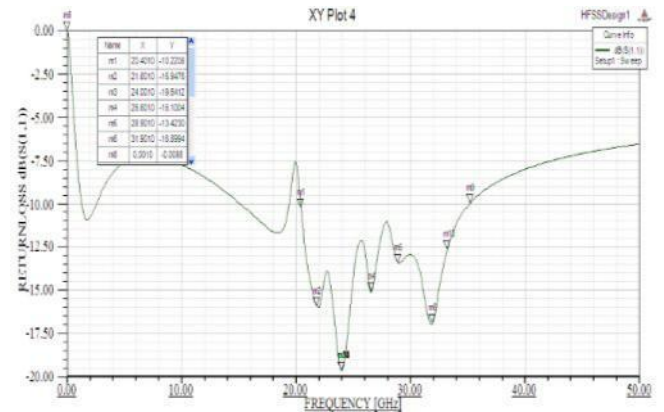


Fig 4: Return Loss Graph

IV. SIMULATION AND EXPERIMENTAL GRAPH

The simulation results are made using the Ansoft HFSS with the finite element method. Fig.1, displays the proposed 1×2 patch array is designed. It mainly fabricated to cover the measured frequency range from 15 to 35 GHz for S11<=-10 db. It includes the wide bandwidth in k-band. Fig.1, demonstrates that the proposed patch array operates at 15 to 35 GHz for measured -10-Db impedance bandwidth. The proposed design indicates better performance compared to other wide band patch arrays. The measured and simulated radiation patterns in the xz-plane(H-plane) and yz-plane(E-plane) at 9.5 and 9.8GHz for the proposed array shown in Fig.1, The gain of the 1×2 and 1×4 patch arrays within the operational bandwidth is 7 and 8 dB, respectively.

IV. GAIN

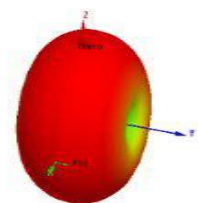
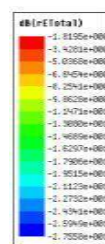


Fig 5: 3D Radiation Pattern of the Patch Antenna

A. VSWR

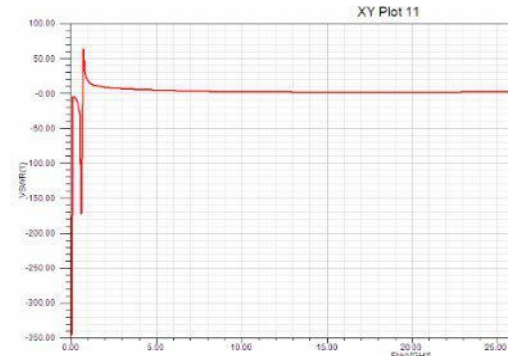


Fig 6: VSWR graph

V.CONCLUSION

In this paper, an attempt has been made to enhance significantly. The bandwidth of the suggested 1×2 and 1×4 patch array by introducing the pattern with disparate arms and CPW-to-slot line feeding technique. The 1×2 and 1×4 patch arrays include 15 to 35 GHz for wideband operation in k-band. The wide band operation shows that it can predict and explain the broad band properties of the proposed antenna.

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