Electromagnetically Coupled Multilayer Patch Antenna for 60 GHz Communications

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I. INTRODUCTION

Demand of gigabit data rates for wireless communications has been increasing exponentially for the last decade. Availability of 60 GHz license free band (57 - 66 GHz) has provided great opportunity to fulfill this demand. One of the essential requirements for high data rate compact solutions is the implementation of high gain planar antenna arrays for integration simplicity with other elements [1].

This work presents a two layer microstrip patch antenna where the top circular patch is electromagnetically coupled with bottom rectangular patch. The dimensions of both the patches are set to provide a broadband impedance matching. Layered layout of this antenna is shown in Fig. 1 (a). Antenna is fed at center layer (L2), by 50 Ω microstrip line. A 5 mil thick high quality millimeter wave substrate Rogers RO3003 with ϵ_r = 3 and tanδ = 0.0006 has been used as top (L1) and bottom (L3) layers, while 4 mil Taconic FR-27 has been used as prepreg between two layers. As shown in Fig. 1 (b), microstrip line (on L2) to GSG (on L1) transition has been designed for antenna measurement.

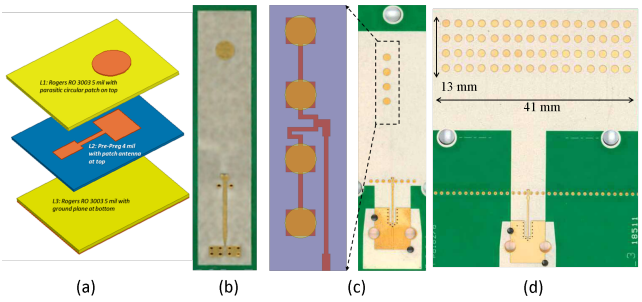

Fig. 1: (a) Layered view of single element antenna (b) Top view of fabricated single element antenna with microstrip (on L2) to GSG (on L1) transition through via (c) Centrally fed 4-element array (d) 4x16 antenna array fed through 1:16 power divider

The same concept of electromagnetically coupled multilayer patches is used to design a centrally fed 4-element antenna array. A top view of the fabricated antenna array is shown in Fig. 1 (c) where each element is half wavelength apart. A similar 4-element antenna array is used to design a 4x16 array, shown in Fig. 1 (d). A 1:16 power divider is used to measure this array.

II. RESULTS

Measured return loss for single element, 4-elements centrally fed array and 4x16 array is shown in Fig. 2. Return loss for single element antenna shows couple of peaks above -10 dB, while 4-element centrally fed array and 4x16 array have almost same $<$ -10 dB impedance bandwidth of 8 GHz (57-65 GHz). Measured maximum gain of 4-element centrally fed array and 4x16 antenna array is 12 dBi and 18.7 dBi respectively.

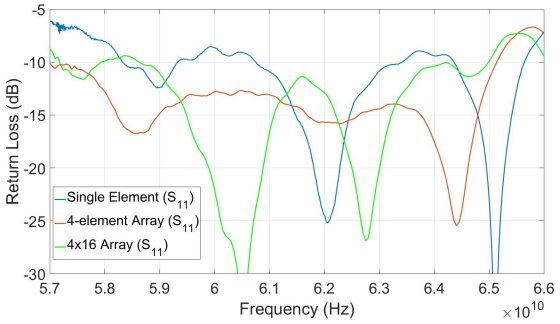

Fig. 2: (a) Measured return loss of single element antenna

III. CONCLUSIONS

Broadband electromagnetically coupled patched antenna and antenna arrays are presented in this paper. Both 4-element centrally fed array and 4x16 antenna array show $<$ -10 dB impedance bandwidth of around 8 GHz (57-65 GHz) while peak gain of 12 dBi and 18.7 dBi respectively.

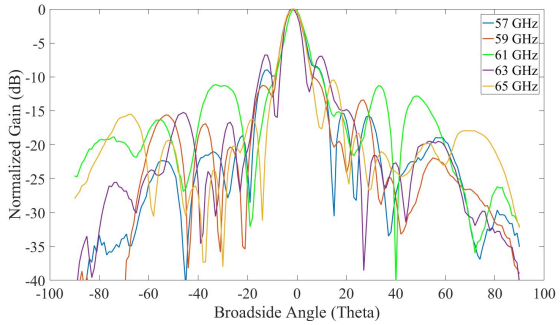

Fig. 3: Measured H-plane radiation pattern of 4x16 array for 57, 59, 61, 63 and 65 GHz

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