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Swami Keshvanand Institute of Technology, Management & Gramothan, Jaipur

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Design and Analysis of a Compact Size 4-element MIMO Antenna for Millimeter Wave 5G Communication Systems

Suman Sharma
Department of Electronics & Communication Engineering
Swami Keshvanand Iinstitute of Technlogy, Management and Gramothan
Jaipur, India
sumansharma@skit.ac.in

Orchid ID : 0000-0002-2680-7756

Mukesh Kumar
Department of Electronics & Communication Engineering
Swami Keshvanand Institute of Technlogy, Management and Gramothan
Jaipur, India
mukesharora@skit.ac.in

Orchid ID : 0000-0002-7016-8963

***Abstract*— In this article a four-element microstrip MIMO antenna is proposed which resonates at 28 GHz frequency with overall dimension 12x 12x 0.8 mm3. Modelling and simulation of the proposed antenna has been done using CST studio suite with dielectric material Rogers RT 5880 having permittivity of 2.2 and tangent loss 0.0009. The antenna has a 1.1 GHz bandwidth between 27.5 and 28.6 GHz. The proposed antenna has an envelope correlation coefficient of less than 0.0015 and a diversity gain of 10.The compact size, easy structure, high gain and good isolation between all ports make this antenna a good option for recent and upcoming 5G communication systems.**

Keywords: MIMO, 5G, mmwaves, Isolation, ECC

I. INTRODUCTION

The fifth generation's (5G) rapid evolution improves the performance of wireless communication networks by reducing latency, improving data rate, connectivity, and spectral efficiency.[1], [2].

The 28 GHz band is the most significant of the various frequency bands that the 5G standard has defined. [3]. Frequency ranges between 25 GHz and 70 GHz were assigned by the FCC for use with 5G applications [4], [5]. In order to reduce the attenuation that these bands experience due to atmospheric absorption and path loss, the researchers and antenna developers design antennas with wideband properties and high gain [6]–[10]. Additionally, MIMO technology uses more antenna elements to increase system capacity, improve transmission quality, and reduce multipath issues [11]. Therefore, Adopting a MIMO system with excellent isolation between antenna elements can improve the system's overall performance, including reliability, high capacity, high data rate and lower multipath effect [7],[8]–[16]. Various papers on 28 GHz and their MIMO configurations have been studied [8], [9], [13]–[15], [17]–[19] [7],[21], [22], [11]–[14], [20].

In this article, a 4 port MIMO antenna is designed for 28GHz resonance frequency using a single element antenna designed first, as reference. Overall design procedure starting from single antenna to 4 port antenna is discussed with results and findings.

II. SIGLE ELEMENT ANTENNA

A single element antenna designed with CST studio suite shown in

Figure 1. Proposed single element antenna is designed over Rogers 5880 substrate with dielectric constant as 2.2 and thickness as 0.79 mm. Dimension of this antenna is as follows: Substrate $L_s \times W_s \times H = 6 \times 6 \times 0.79$ mm^3, Patch radius R = 2.23 mm, Feedline dimensions $F_L \times F_w$ = 2.47 mm × 1.56 mm, cut S = 0.3 mm, dimensions of ground plane = $L_g \times W_g$ = 6 mm × 6 mm.

This single element antenna resonates at 28 GHz frequency with operating bandwidth as 1.14 GHz (27.43 GHz- 28.57 GHz), making it an excellent option for 5G communication devices.

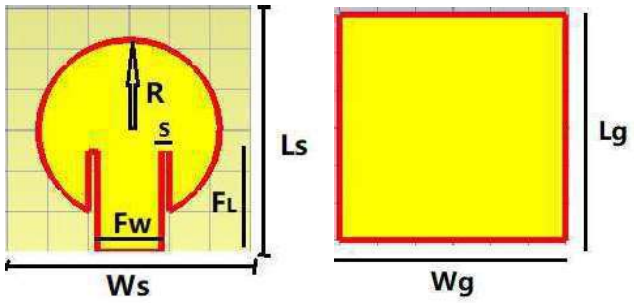

Figure 1 Single element antenna design, Front(a), Back(b)

Figure 2 shows the plot of reflection coefficients (dB) with respect to frequency (GHz). Proposed antenna shows a excellent impedance matching at resonance frequency and observed bandwidth is 1.14 GHz. Figure 3 shows the surface current distribution of single port antenna and it can be seen from the figure that the distribution of surface current is along with the feed line and surface of patch radius

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