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THE NOVEL COMPACT ANTENNA DESIGN FOR 5G APPLICATIONS

M.SREEHARI (Assistant professor) Dept ECE
P.Mahendra, N. Srivani, P. Jashwanth, K.V. Krishna reddy, A.V. Sai
Department of Electronics and Communications
PBR Vits, Kavali, Nellore, Andhra Pradesh,

Abstract : **The rapid evolution of 5G communication systems demands antennas with low profile, lightweight, high gain, and simple structures to ensure reliability, mobility, and high efficiency. This work presents the design of a compact slotted micro strip antenna with the size 7 × 7 mm^2 for 5G applications, operating at 28 GHz. The proposed antenna is designed and simulated using CST Microwave Studio software on a Rogers RT5880 substrate with a dielectric constant of 2.2, a thickness of 0.8mm. To meet the design requirements, the patch is optimized with specific slot loading to enhance its performance. Key parameters such as return loss, VSWR, bandwidth, and gain, are analyzed. The results demonstrate the antenna's potential for reliable and efficient operation in 5G communication systems, making it a promising candidate for next-generation wireless networks.**

Keywords: Slotted micro strip antenna, VSWR, gain, and 5G.

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I. INTRODUCTION

1.1 ANTENNAS

Antennas are the basic components of any wireless communication system and are connecting the transmitter and receiver through space as the communicating medium. They play a vital role in wireless communications. An antenna (or aerial) is an electrical device which converts electrical currents into radio waves, and vice versa. It is usually used with a radio transmitter or radio receiver. In transmission, a radio transmitter applies an oscillating radio frequency electric current to the antenna's terminals, and the antenna radiates the energy from the current as electromagnetic waves (radio waves). In reception, an antenna intercepts some of the power of an electromagnetic wave in order to produce a tiny voltage at its terminals that is applied in a receiver to be amplified. An antenna can be used for both transmitting and receiving.

"The Antenna, like eye, is transformation device that converts electromagnetic photons into circuit current; but, unlike eye, the antenna can convert energy from circuit into photons radiated in to the space".

DEFINITION:

An antenna (or Aerial) is an electrical device which converts electric currents into radio waves, and vice versa. Antennas are essential components of all equipment that uses radio. They are used in systems such as radio broadcasting, broadcast television, two-way radio, communication receivers, radar, cell phones, and satellite communications, as well as other devices such as garage door openers, wireless microphones and Bluetooth enabled devices. Antennas were used for the first time, in 1889, by Henrich Hertz (1857-1894) to prove existence of electromagnetic waves predicted by the theory of James clerk Maxwell. The important properties of an antenna are the radiation pattern, radiation intensity Polarization, Gain, Directivity, Power gain, Efficiency, Effective aperture or area, self and Mutual inductance, Return loss, Mutual coupling, Bandwidth etc.

OBJECTIVE OF THE PAPER

This paper aims to propose a compact size microstrip antenna with low profile and good performances for 5G mobile communications operating at 28 GHz. To achieve this objective, a compact antenna is proposed. One is a conventional rectangular microstrip patch antenna with quarter wave transformer is designed and analyzed, and the second antenna is a slotted antenna that obtained by modifying the conventional rectangular microstrip antenna to improve the gain, bandwidth, and antenna performance; the modification is done with loading specific slots in radiator. CST MW STUDIO software is used to simulate and performance analysis of these antennas.

PROPOSED DESIGN

The procedure of antenna design includes design of the radiator patch, the feed line, and the matching element. The specific parameters that need to design a microstrip antenna are the dielectric constant of the substrate (εr), the height of the substrate (h), and the resonant frequency (fr). In this work, a conventional rectangular microstrip antenna (Antenna_1) and a slotted microstrip antenna (Antenna_2) are designed and simulated using CST MWS software on Rogers RT5880 substrate with dielectric constant of 2.2, thickness of
0.8 mm, and loss tangent 0.02, to operating at 28 GHz.

Proposed Antenna

By comparing all the designs of parameters return loss, operating frequency, bandwidth, VSWR, peak gain, directivity and efficiency. We proposed a design of a directional single element slotted microstrip antenna with compact size to operate at 28 GHz for 5G applications.
The dimensions of the radiator, feed line, substrate, and slots in patch are adjusted using CST MW STUDIO software to reach the preferred design of antenna that cover 28GHz for 5G applications. The

Fig. 4.13 Configuration of a proposed Antenna

PROPOSED DESIGN ANALYSIS:

The variation of the return loss versus the frequency of the slotted antenna is shown in Figure 5.1. It can be observed that the return loss of -19.241 dB at the resonant frequency. Based on *10 dB return loss, the proposed antenna has a band width of 1.98 GHz, is obtained, in the range of 27.082 to 29.069 GHz for*

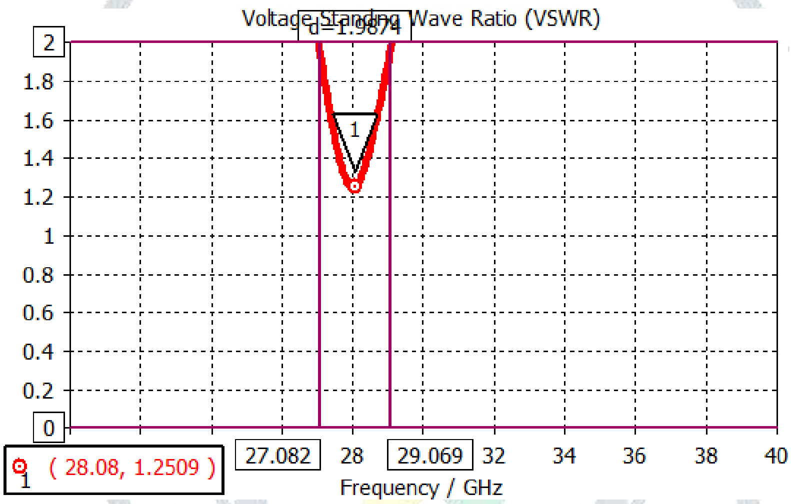

Figure 5.3 illustrates the variation of VSWR with the frequency

Figure 5.2 illustrates the variation of VSWR with the frequency. From the figure, it can be noted that VSWR is 1.25 at 28 GH. For VWSR less than 2, Proposed Antenna covers the range of
27.082 to 29.069 GHz for 28 GHz band.

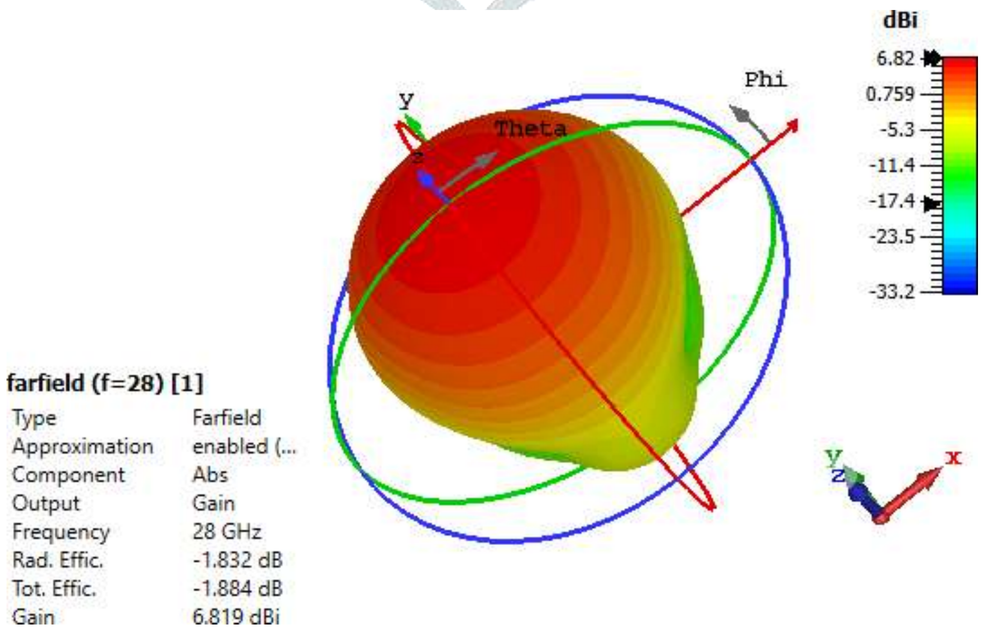

Figure 5.4 illustrates the variation of Gain

The proposed antenna has a compact size, acceptable gain, and bandwidths for 28 GHz band. By compact size we can use this antenna in smart watch for 5G Applications.

FABRICATION AND MEASUREMENTS

A prototype of the proposed antenna was fabricated and its fundamental characteristics were tested in the Antenna Laboratory at the SRM University, Chennai. As can be seen, the S-parameters of the antenna including S11 characteristics were measured using the Keysight vector network analyzer. The measured S11-parameter results of the prototype are displayed in Fig. 5.4. As illustrated, the antenna provides very good impedance matching (reflection coefficient more than -40 dB) at 28.35 GHz. In addition, compared with the simulations, it can be confirmed that there is a good agreement between them.

Fig. 5.5 fabricated antenna with measure S11-parameters

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