Study and Analysis of Substrate Dependent Microstrip Patch Antenna for Advance Communication

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***Abstract*—This work presents a novel slotted antenna design using the FR4 epoxy dielectric substrate. In this study, a comparative analysis of slotted antennas with coaxial feeding is performed using various dielectric substrates, and the same antenna is then designed by modifying the coaxial feed's co-ordinates to validate the influence on antenna performance. At the desired frequency, it can be demonstrated that FR4 epoxy offers the suitable impedance matching and bandwidth. The operational frequency response(s) of the antenna are 6, 8.2, 10, and 12 GHz, and the dielectric substrate material used in construction is FR4 epoxy. The maximum reflection coefficient obtained is -19.9 dB at 5.9 GHz resonating frequency and achieved gain of 5 dBi. The antenna is intended for use in wireless communication systems**

Keywords— Dielectric constant, Patch, Coaxial feed, Substrate, Advance Communication

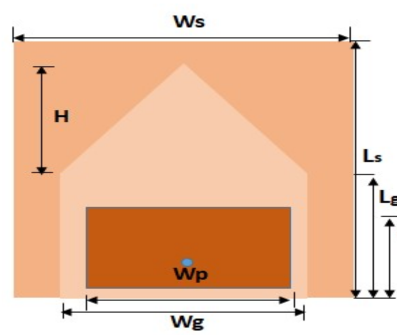
I. INTRODUCTION

In this modern world, advancements in wireless technology have created a huge demand for small, high-bandwidth antennas to be employed in commercial communication systems. Researchers have investigated into a number of techniques for producing unique wideband microstrip antennas in order to develop the technology of modern communications systems. [1–11]. For a specific wireless system application in the past, a dedicated antenna with a predetermined radiation characteristics was used. This problem was solved by increasing the fractional bandwidth of microstrip antennas, permitting one antenna to meet the bandwidth needs of many applications. The design of a low-cost antenna involved the application of several techniques and materials. For the construction of patch antennas, which is significant [2], we often use inexpensive substrate materials. The substrate [3] is the main factor in a microstrip antenna's mechanical strength. The dielectric used is also responsible for the reduced electrical characteristics (space waves) of the antenna. The substrate used in the design of a microstrip antenna has a significant impact on the manufacturing cost. Surface waves created on the antenna reduce the total power available for direct radiation by a minor fraction. As a result, attention must be given while choosing a substrate to ensure that the electrical and mechanical standards of the antenna are upheld [4-6]. The loss tangent and dielectric constant, in addition to how they vary with temperature and frequency, homogeneity, dimensional stability, and other substrate features, are all taken into account in selecting a dielectric material [7-8]. To increase the bandwidth of a printed patch, utilise a thick substrate with a low dielectric permittivity. In this study, we designed and tested a small slotted antenna with coaxial feeding on various substrates with the same structure. The effect on antenna performance is then tested by designing the identical antenna with the modified coaxial feed's coordinates. We used various substrate materials and conducted a comparative investigation of antenna properties in the proposed structure. The advantageous features of the antenna are compact size, low cost substrate and can easily be manufactured. The compact profile of the antenna makes it suitable to be included in wireless communication devices designed to be operated in the proposed frequency range(s).

II. ANTENNA DESIGN

The proposed antenna is designed using FR4 epoxy substrate having dielectric constant 4.4. Figure 1(a) represents the proposed antenna structure with coaxial feeding at the centre of the patch and the dimensions of the substrate and patch are 30 x 30 x 1.5 mm^3 and 20 x 11 mm^2. Figure 1 (b) shows the image of the fabricated prototype. Using eq.1 we can calculate the equilateral triangle height (H). That the H value can be fixed as per dielectric value,

$$H = \frac{2\times C}{3f_r\times\sqrt{\mathcal{E}_r}} \quad (1)$$



(a)