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Design and Simulation Microstrip Antenna Monopole for K Band Frequency

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Abstract— **Planar monopole antennas continue to hold promise for advancement in communication systems for a variety of uses. This study will discuss a planar monopole antenna using Rogers substrate (εr) = 2.2 × 10−12 F·m−1. There are several important parameters studied in relation to antenna performance, including VSWR and Gain. Dimensions Ls (1mm,2mm,3mm,4mm) and Ws (0.5mm,1mm,1.5mm,2mm) to determine the Gain and VSWR of the suggested antenna, are variously associated with wavelength. As a consequence, the antenna with the lowest VSWR 1.67 was created from the four Ls and Ws trials. The point with the lowest VSWR operates at a resonant frequency of 22.74 GHz with a return loss of -12.23dB and gains up to 4.65dB. From the results of the VSWR, it can be concluded that the planar monopole antenna can work well because it has a VSWR value of < 2. From the above result it can be concluded that the planar monopole antenna can work well in the application of low orbit satellite communication or K Band Frequency.**

Index Terms— **Antenna microstrip; Gain; K Band Frequency; Return Loss; VSWR.**

I. INTRODUCTION

In modern life, satellite communication are often utilized. Example of applications include data transmission, mobile phone networks, and television broadcasting. Satellite are often categorized into a number of categories based on how there are used in communications. What sets each mission apart the other are its service offerings, costumer capacity, and service area. A utilized, the method by witch numerous users can share a satellite's ability to be update are among its other attributes. The spectrum distribution, power levels, and coverage regions should be taken into the most consideration while defining and antenna design. The four primary mission type are fixes satellite service, direct to the home internet services, broadcast satellite service and digital audio services. Direct broadcast service system are a common abbreviation for BSS systems [1]. The microstrip antenna has been one of the most frequently utilized antennas for space applications in recent years [2], and this trend is anticipated to continue. Microstrip radiator is made up of a metallic patch element printed of thin layer insulating dielectric placed atop a ground plane in its most basic form [3].

II. LITERATURE REVIEW

2.1. Antenna

By transforming guided waves supported by a guiding structure into radiating waves travelling in free space and vice versa, antennas radiate and receive electromagnetic waves. In order to perform this job, certain requirements must be met, and these requirements have a variety of effects on the antenna design. Above a ground plane, a variety of antennas are often mounted in satellites, and their requirements change depending on the application and mission [3].

2.2. Microstrip patch antenna

Because of the inherent flexibility of microstrip technology, it is feasible to create antennas with variety of designs, single or multilayer arrangements, and band coverage. Additionally, printed antenna in microwave integrated circuited is simple and capable of high levels of integration. A half wavelength resonator with two radiating edges can be compared to a microstrip antenna that is made to function in its fundamental mode. The electric field distribution at the patch's radiating edges, as seen in figure 2.1, is comparable to what of two slot [4-5]

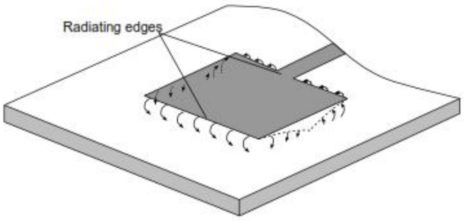

Figure 2.1 microstrip antenna

2.3.. Feeding technique

The feed approaches have a significant impact on a microstrip antenna's electromagnetic performance. Figure 2.2 provides examples of the most popular feeding techniques. The inner conductor of a coaxial cable is lengthened to fit flush against the patch, and the outside connector is soldered to the ground plane to apply feeding systems based on coaxial probes. This method is typically used when the antenna needs to be connected to a typical 50- coaxial probe [4-5].

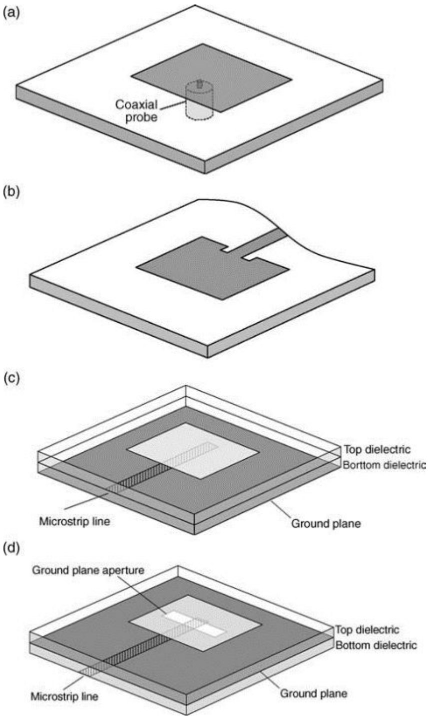

Figure 2.2 Technique feeding (a) coaxial probe; (b) micro strip line;
(c) coupling ground; (d) aperture coupling.

2.5. Impedance matching

The impedance of a transmission line is typically defined as the ratio of voltage to current for a wave traveling through a coaxial wire [6]. It depends on the electrical properties of the conductors and cable materials, and a change in impedance can cause reflection of the wave. If the impedance changes, the wave will be reflected back to the source instead of being transmitted, resulting in a loss of radiation. The amount of lost radiation can be determined by calculating the VSWR (voltage standing wave ratio) caused by the mismatched impedance, which can be done by first calculating the reflection coefficient.

$$VSWR = \frac{1+|\Gamma|}{1-|\Gamma|} \qquad \text{[5]}$$

III. METHOD

The characteristic impedance of a transmission line, like that of a coaxial cable, is determined by the ratio of voltage to current. This study aims to analyze and evaluate the performance of planar monopole antennas, with a design frequency of 20 to 30 GHz, to meet the anticipated structure and performance requirements for satellite applications. Parameters such as the thickness of the specifications, the breadth and length of the monopole, the distance between the ground plane and the monopole, the cut of the substrate's back region, and the size of the printed microstrip on the substrate were considered. Figure 3.1 displays the suggested structural architecture of the monopole antenna shape.

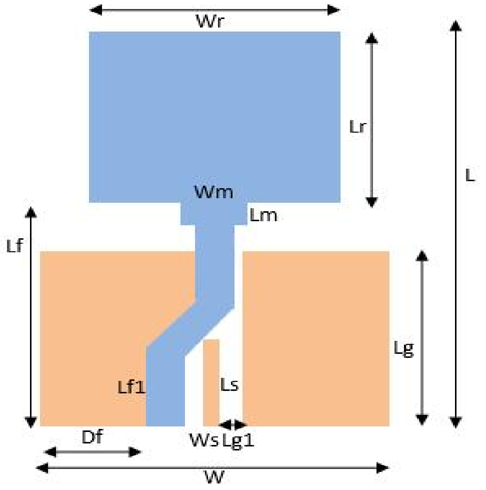

Figure 3.1. Design antenna planar monopole

The fundamental topology of single element of the purposed antenna is based on the development monopole [7]. Antenna structure. 3.1, printed on a substrate with relative permittivity r = 2.2 1012 F/m^1 and thickness of h = 0.787mm, is utilized for 50 ohm impedance changes. Microstrip lines aew used to delivered, with Ws (0.5mm, 1mm, 1.5mm and 2mm) and Ls (width variation) changes in length and width (1mm, 2mm, 3mm, 4mm).

IV. RESULT AND DISCUSSION

WIPL-D EM Simulator has been used to do an empiric calculation on this antenna. The impact of changing the value of the Ws and Ls variation on the gain, VSWR, and S11 parameter. Return loss is too high, reaching -10 dB when Ws are adjusted to 2mm. Figure 4 displays the data retrieval outcomes listed below. The planar monopole antenna has undergone very minor modifications due to changes in the LS's size. You can view the data result in the table below.

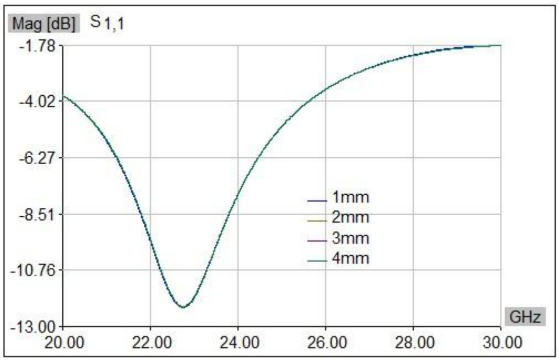

Figure 4.1. S11 affected by Ls variation

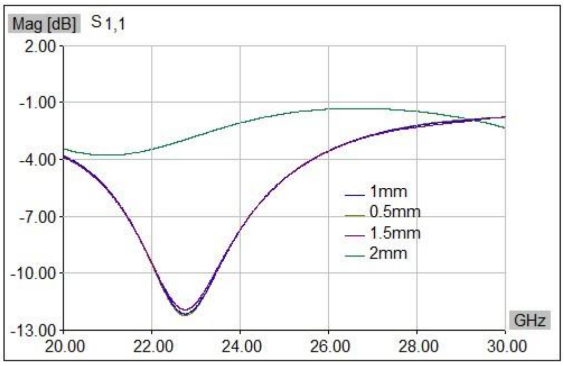

Figure 4.2. S11 affected by Ws variation

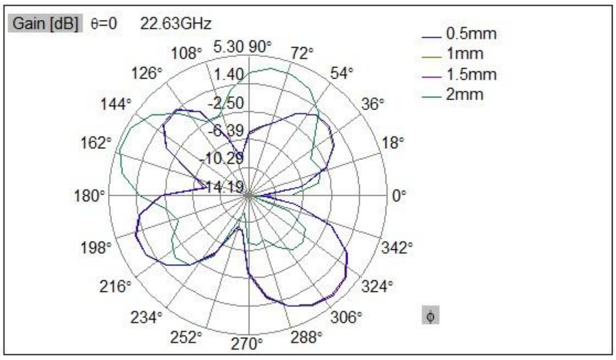

Figure 4.3. S11 affected Gain by *Ws* variation

The gain following the change is too low, as seen in Figure 4.3. The result shows increased gain and resonance frequency after adjusting the Ws to 2 mm. The manner in which the current spreads over the element has a considerable impact on gain and resonance frequency changes. The present spreading is increased by a lesser element. Gain of 4 dB or more and a change in resonance frequency to 22.74 GHz. Figures 4.2 and 4.3 show the final result after adjustments. Figure 4.1 depicts the antenna's gain level for the smith chart's Ls constant value. Smith chart resonance frequency shift at 22.74 GHz ticks at a value of 1,67, and VSWR value hits one at this frequency.

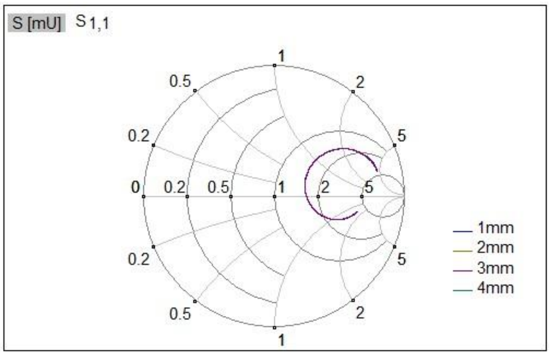

Figure 4.4 Smith Chart affected by Ls variation

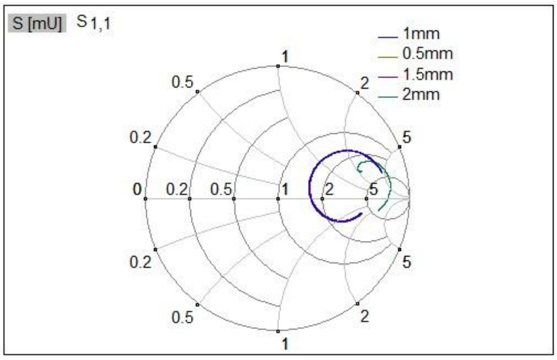

Figure 4.5 Smith Chart affected by Ws variation

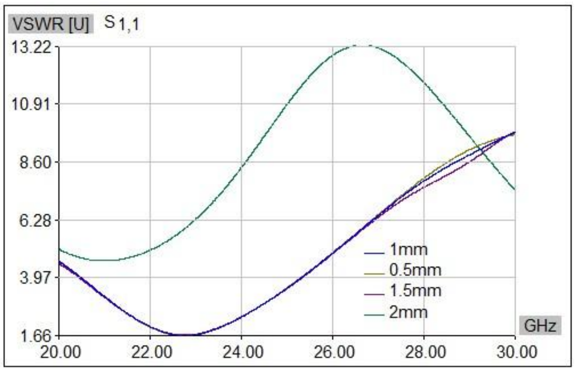

Figure 4.6 Comparasion VSWR Ws variation

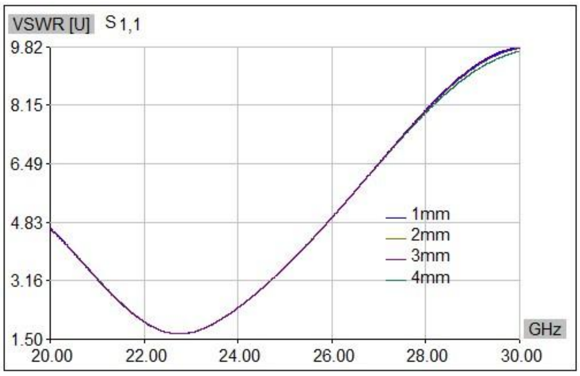

Figure 4.7 Comparasion VSWR Ls variation

The results of the Smith chart in terms of Ls and Ws variations show a change where if the values of Ls variations almost approach the value of 1, which means that the expected result is achieved so that the antenna with dimensions of Ls variations falls into the K band frequency category. Meanwhile, the Ws variations shown in Figure 4.5 show a significant change in the Ws variation with a size of 2mm. The figure indicates that the value moves away from 1, which means that the 2mm dimension in the Ws variation does not fall into the desired antenna category or cannot meet the K band frequency category. Figures 4.6 and 4.7 show the comparison of VSWR from the dimension variations that have been performed.

V. CONCLUSION

Data retrieval analysis and computations by software WIP –D indicate that this antenna operates optimally in terms of element dimensions at frequency resonance of 22.74 Ghz and value of VSWR is 1.67. The main characteristics of this antenna are simple construction and compatibility with K Band Frequency and also low orbit communication satellite.

ACKNOWLEDGMENT

This research is aimed at adding insights into antennas with low orbit satellite communication, this simulation is simulated so that it allows other researchers to make fabrications of these antennas, hopefully with the presence of this study inter-satellite communications especially in low orbits in running properly.

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