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DESIGN AND IMPLEMENTATION SQUARE PATCH MICROSTRIP ANTENNA AT FREQUENCY 2.3 GHz

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Abstract— In this research has been done the design and implementation of microstrip antenna for WiMAX application working on a frequency of 2.3 GHz, with the size of 5 x 5 cm and generate the appropriate parameter regulation WiMAX Dirjenpostel [1]. The method used i.e. square patch, proximity coupled feeding and modified slot on the antenna ground. Its design stages, namely to determine the initial size of the antenna, simulation, and optimization. Occurs the difference measurement results and simulations that are caused by factors of fabrication and measurement methods are not ideal. The difference in those results i.e. increase the gain of 6.8634 dB or increased 363.79% (simulated results 1.8866 dB, measurement results 8.75 dB), decrease the bandwidth of 36 MHz (from 131 MHz be 95 MHz). For differences in the VSWR of 0.1258 and the input impedance of 3,666 Ω it can still be tolerated and the radiation pattern produced is identical.

***Index Terms*—Microstrip Antenna, Square Patch, Proximity Coupled, Modified Slot.**

I. INTRODUCTION

IN the previous research, entitled "Design and Implementation of Microstrip Array Antenna with Square Patch on the WiMAX 2.3 GHz Frequency for Application" [2] has been made microstrip antenna on the frequency 2.3 GHz for WiMAX application, the methods used i.e. the square patch, microstrip feedline feeding, and array method. The antenna parameters resulting from such research i.e. works at frequency 2295 - 2414.5 MHz, Return Loss -25.5924 dB, VSWR 1,1109, Gain 3,3870 dB and has a size of 4.317 x 21.911 cm. From the parameters produced, the antenna performance is in accordance with WiMAX regulation standards from the Dirjenpostel, but the antenna has the relatively large size so it would be difficult to integrate with the other devices and expensive fabrication cost, Therefore it is needed the other antenna can produce better performance in accordance with the Dirjenpostel regulation and have the smaller size. The goal of the research is to make the microstrip antenna at frequency 2.3 GHz for the WiMAX applications, the antenna that will be made are expected can produce parameters that are in accordance with the regulations of the Dirjenpostel and the size of 5 x 5 cm. In the journal entitled "Slotted-Microstrip Antenna with Ground Plane Modified for Performance Enhancement Parameters" [3] showed that by using the square Patch, Proximity Coupled Feeding and Modified slot on ground antenna can increase the value of the bandwidth of 5% (from 118.75 MHz to 125 MHz).

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II. METHODOLOGY

The design procedure on this research, the first stage is to determine the parameters that must be achieved, the parameters used, namely Regulation of WiMAX from Ditjenpostel, the second stage is to determine the type of material used, in this study the type of material used is FR4-Epoxy.

The third stage is the calculation of antenna size which consists of calculating patch size, substrate surface area, and feeding channel size.

After the calculation is done then obtained the initial size of the antenna, next design antenna using Ansoft HFSS 15.03 software in accordance with the size of the antenna has been obtained, After the design completed the process of simulation results are compared to the parameters of the Dirjenpostel, from those results showed the parameters produced are not in accordance with the regulations of Ditjenpostel, so done the optimization to antenna with resizing the antenna consisting of the size of the patch and length of feeding channel compared to changes of parameters that occur.

From the literature study that has been done, it shows some of the impacts resulting from the proximity coupled feeding i.e. proximity coupled feeding techniques has better performance compare to the coaxial feeding techniques [4], the maximum bandwidth can be achieved by proximity coupling [5], using proximity coupled technique has lead to improve the bandwidth [6], proximity coupling gives the best impedance matching and radiation efficiency and coaxial feeding technique gives the least bandwidth [7], the design of an efficient proximity coupled feed rectangular microstrip patch antenna with defected ground structure produce the high return loss at the resonant frequency [8]. from the optimization results, the antenna with the patch size of 27.95 mm and the feed channel length of 19 mm produces parameters that are in accordance with the Dirjenpostel regulation.

The next step that is performing modification slot on the ground antenna with the aim to improve the antenna bandwidth without changing the size and decrease the gain antenna significantly, design modification of the slots which used i.e. the rectangular shape, To obtain the desired antenna parameters, optimization is carried out by modifying the patch size, the feeding channel length, and slot size. From several literature studies about the method of modify slot on the antenna ground plane some result are obtained i.e. the defected ground plane can improve antenna performance such as compactness, gain, directivity and radiation efficiency [9], the rectangular microstrip patch antenna with rectangular slot defective ground structure is improved in terms of bandwidth and return loss as compared with the rectangular microstrip patch antenna without defective ground structure. The Bandwidth of the rectangular microstrip antenna is increased from 56 to 67 MHz and return loss is improved from -20 dB to -39.31 dB [10]. The radiation efficiency, bandwidth and surface wave power of microstrip antenna have been enhanced by using suggested new nano-composite materials with easy fabrication, high performance and low cost [11], proximity coupling and X slot techniques are improving the bandwidth of 8.17% [12].

III. RESULT AND ANALYSIS

After simulating and getting the desired antenna specifications, next fabricated the antenna according to the specification, below are the results of the fabrication of antenna i.e. :

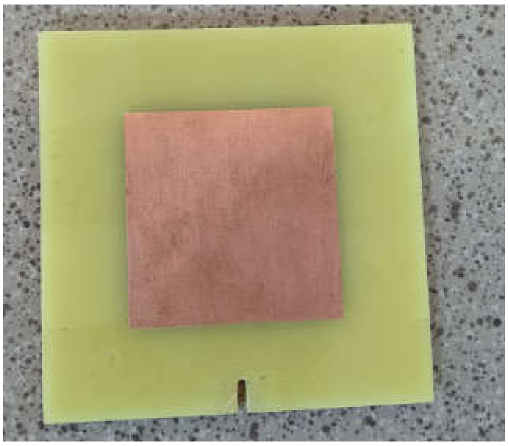

Figure 1 First substrate of the front view

Figure 1 shows the front view of the first substrate consisting of the square patch made from copper, the type of material used, i.e. Epoxy-FR4.

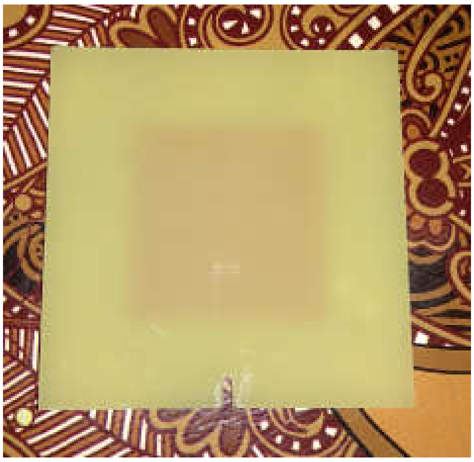

Figure 2 The first substrate of the back view

Figure 2 shows the back view of the first substrate there is only the FR4-Epoxy without copper material

Figure 3 The second substrate of the front view

Figure 3 shows the front view of the second substrate consisting of the feeding channel.

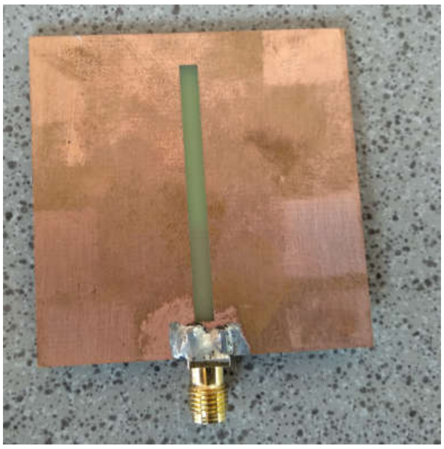

Figure 4 The second substrate of the back view

Figure 4 shows the back view of the second substrate consisting of a ground plane and slot.

After fabrication, done the measurements and the results of these measurements are compared with the results of the simulation, below is the fabricated antenna and the comparison of measurement results and simulation results i.e. :

Table 1. Comparison of Measurement Results and Antenna Simulation

Parameters	Simulation Results	Measurement Results
Return Loss (dB)	-26.3558	-19.676
Working Frequency (MHz)	2298.5 – 2429.5	2305 - 2400
Bandwidth (MHz)	131	95
VSWR	1.1052	1.231
Input Impedance (Ω)	50	53.666
Gain (dB)	1.8866	8.75 dB
Radiation Pattern	Directional	Directional
Polarization.	Linear	Linear

Based on the table above shows that there is the difference between the measurement results and simulations, namely the shift of 6.5 MHz for the lower frequency and 29.5 MHz for the upper frequency, there was the decrease in bandwidth of 36 MHz from 131 MHz to 95 MHz. The VSWR difference is 0.1258, the input impedance is 3.666 Ω, the gain is 6.8634 dB. From these results, the difference in VSWR and Input Impedance parameters can still be tolerated because the value is not significant, for the bandwidth value there was the significant decrease in the amount of 27.48% and a very significant gain increase reaching 363.79%, while the radiation pattern produced was identical with simulation result.

Factors that affect the difference of the measurement and simulation results of the antenna i.e. the fabrication of antenna still using conventional method, space anechoic chamber that does not fit standard and the method of measurement which is not ideal, so that resulting in the radiation that interferes.

IV. CONCLUSION

After doing the simulation process and measuring the antenna, there are some conclusions that are produced, namely as follows :

1. The results of the Microstrip Antenna simulation produce parameters that are suitable for the purpose of the study, which is 5 x 5 cm in size, works on frequency 2298.5 - 2429.5 MHz, with return loss value of -26.3558 dB, 131 MHz bandwidth, VSWR 1.1052, input impedance of 50 Ω and gain of 1.8866 dB and directional radiation pattern.

2. The method used is the proximity coupled technique and modification of the ground slot which has an effective impact on increasing antenna performance as shown in point number 1.

3. The result of measurement is the antenna works at the frequency of 2305 - 2400 MHz, with return loss value of -19,676 dB, bandwidth of 95 MHz, VSWR 1.231, the input impedance of 53.666 Ω and gain of 8.75 dB.

4. There are differences in measurement results and simulation results caused by antenna fabrication factors and antenna measurement methods that are not ideal, but it gives better results on the gain, which increased by 363.79%, for bandwidth parameters decreased by 27.48% for VSWR parameters which decreased by 11.38%, Input Impedance decreased by 7.332%.

5. The results of the simulated Antenna generate parameters in accordance with the regulation of WiMAX Dirjenpsotel, for measurement results there is a shift in work frequency, increase in gain and decrease in bandwidth, so that there is a difference between the simulation results and measurement results but in terms of performance or parameters produced in accordance with the Dirjenpostel WiMAX regulations.

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