Trimmed Equilateral-Triangular Microstrip Patch Antenna for Wireless LAN Application

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Abstract — An equilateral-triangular Microstrip Patch Antenna (MPA) for wireless LAN application is proposed using trim method to reduce dimension of the patch and the substrate. It is demonstrated that by trimming one of the angle of the triangular, it can change the resonant frequency as well as reduce the overall size of the triangular itself.

Keywords—Equilateral-Triangular, Microstrip Patch Antenna (MPA), wireless LAN, Trim, Reduce.

I. INTRODUCTION

The need of wireless communication such as wireless LAN has grown very rapidly today. Wireless system expected to be low profile which needs smaller dimension because of its characteristic to be mobile. Microstrip patch antenna is one of the best choices for wireless LAN system. Its dimension that tends to be small can make the overall dimension of the antenna very small too. The equilateral-triangular shape is chosen because compared to other shapes with the same resonant frequency, it has the relatively smallest dimension [1].

In this paper the idea of reducing the patch is to gain efficiency in fabrication. Some designs of equilateral-triangular MPA for wireless LAN such as “Design of a Dual Patch Triangular Microstrip Antenna” have a side length patch of 52.1 mm[2], “A Broadband Design for a Printed Isosceles Triangular Slot Antenna for Wireless Communications” which have side length patch 51.5 mm[3], “Triangular Patch Antennas for Dual Mode 802.11a,b WLAN Application” which have side length patch 63.9 mm[4] can still be smaller. Therefore the design proposed here has smaller dimension than [2],[3] and [4], which are the side length of the patch is only 46 mm exclude one angle which have been trimmed.

Most wireless LAN used in offices today uses the standard form IEEE which is IEEE 802.11g, operate at 2.4 GHz. Therefore the design of this antenna will operate at 2.4 GHz (2.4—2.4835 GHz). This antenna design uses feeding technique electromagnetically coupled with single microstrip line feed to increase its bandwidth.

II. ANTENNA CONFIGURATION

The design of proposed equilateral-triangular with a trim is shown in figure 1. Substrate properties used for this paper are GML with parameters shown in table 1.

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>VALUE</th>
</tr>
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<tbody>
<tr>
<td>Type</td>
<td>GML 2032 060 1/1</td>
</tr>
<tr>
<td>Relative Dielectric Constant</td>
<td>3.2 ± 0.05</td>
</tr>
<tr>
<td>Tangensial Loss</td>
<td>0.0025</td>
</tr>
<tr>
<td>Thickness [cm]</td>
<td>0.152 ± 0.0076</td>
</tr>
<tr>
<td>Thermal Conductivity [W/mK]</td>
<td>0.232</td>
</tr>
</tbody>
</table>

Fig. 1. Dimension of the antenna

The side length (a) of equilateral-triangular is determined by calculation:
The equilateral-triangular patch is than designed and combined with the feeding technique microstrip line in simulation program. The first design will be simulated but at this point the frequency does not match with the frequency wireless LAN 2.4 GHz. The simulation shows the frequency is lower than the desired one. Therefore there need to be further adjustment by experiment. Design process will be divided into two part. Part 1 is about to decide the length of an angle that have to be trimmed to fulfill the resonant frequency 2.4 GHz. Part 2 is about to adjust the length of the microstrip line as affected of step in part 1.

Figure 2 shows the first design made. The length of the microstrip line (l₁) will be set to 13 mm. This is the best length that can achieve because value of return loss is very low, exceeding -40dB but as mentioned above, doesn’t match the frequency of WLAN 2.4 GHz.

Part 1. this step is to find the desired frequency which is 2.4 GHz. To adjust this, the dimension of the patch have to be reduced [5]. The usual method to reduce the dimension of the patch is by recalculating the side length of the antenna. In this paper, it proposes another method of reducing the patch that is by trimming (t) on of the angle of the equilateral-triangular as shown in figure 4. This method is the same as the first method only easier to be done and eventually easier in fabrication. In this step, the length of the microstrip line must be modified in order to maintain the matching of the microstrip line. The best result for this step is t = 8.25 mm and modified microstrip line (l₂) is 18 mm and shown in figure 3.

III. RESULT AND DISCUSSION

The results of the simulation and measurements from fabrication of the equilateral-triangular design using trim method in previous chapter is presented here.

Figure 6 shows simulation and measurement result of the final configuration using trim method. In this last step (final configuration) results was given by (t = 8.25 mm and l₂ = 18.25 mm.).

Measurement result in figure 6 shows the bandwidth is from 2.3993—2.4836 GHz (84.3 MHz or 3.5%) for VSWR ≤ 2. Figure 7 shows the return loss of a 3.5% bandwidth (at -9.54 dB) and figure 8 the radiation pattern of the design with the main lobe at 0°. These figures shows that this design is suitable for the IEEE Standard 802.11g.
IV. CONCLUSION

A design of equilateral-triangular microstrip patch antenna has been proposed to meet the wireless LAN frequency using trim method to reduce the overall size of the antenna. Result of simulation shows that the antenna meet the requirement frequency 2.4 GHz with bandwidth achievement is 84.3 MHz or 3.5% at VSWR ≤ 2 (return loss -9.54). The design has achieve its goal to reduce the dimension of the patch and also reduce the overall size of the antenna.

REFERENCES


[4] Raul R. Ramirez, Franco De Flaviis, “Triangular Patch Antennas for Dual Mode 802.11a,b WLAN Application”, Department of Electrical and Computer Engineering, University of California, Irvine, USA