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The Shape on Propeller Patch Microstrip Antenna for Analog Television (450-750 MHz)

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Keywords

Microstrip Antenna, PCB, Indoor Antenna, Analog Television

Microstrip antenna arrangement technology is in the form of two mutually parallel conductive layers separated by a dielectric substrate. The top conductor is a thin piece of metal (usually copper or gold), this antenna applications typically used in radar systems, GPS and many more. This is because the antenna basis of this technology has a relatively smaller size with good reliability performance. By using microstrip-based technology, this is expected to make an antenna with a little more reliable and can be used to replace the role of indoor or outdoor antenna on analog television signal reception. This study used a substitute dielectric material in the form of a PCB antenna. The advantages of this antenna in addition is a small shape, the aesthetic is also quite good and does not need outdoor installation.

Introduction

The antenna is a very important component in the communication system especially radio communications. The antenna function is as a transducer that converts electrical waves on the transmission line into an electromagnetic wave in a vacuum. While the official definition of the IEEE antennas by Stutman and Thiele in 1998, the antenna is a part of the transmission and acceptance of a system which designed to radiate electromagnetic waves. For an example is the antenna microstrip antenna.[1] ,[9]

Based on his origin, microstrip consists of two words, namely micro (very thin/small) and strip (bar/piece). Microstrip antenna is an antenna that has a very small size compared to other antennas. Microstrip antenna concept was introduced in the early 1950s in the USA by Deschamps. And in France by Gutton and Baissinot in the new 1970s..[2]

Microstrip Antenna's Basic Structure consists of three core elements, there are the radiation element (radiator), the substrate element, and defense elements. As shown in the figure 1.

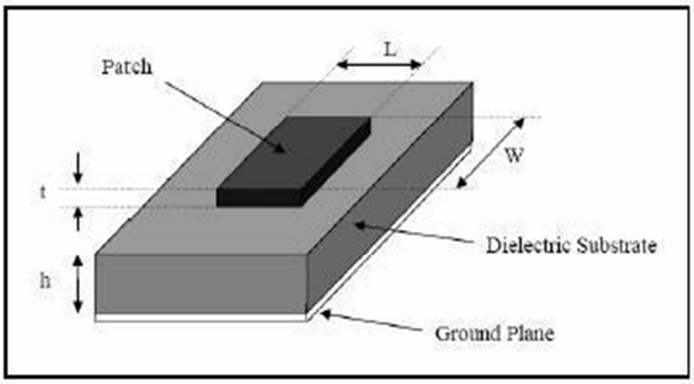

Figure 1. *Elements of the MicrostripAntenna*[2].

Elements of radiation or called Patch, serves to radiate electromagnetic waves into the air. The patch is made of conducting material which is usually used of metal with a certain thickness. That element serves as a dielectric substrate on the microstrip antenna to limiting radiation element and the defense element. This element serves as a grounding in microstrip antenna system, this element is usually made from the same material used in the radiating element.[2]

The Proposed Antenna

One of the things that must be considered to obtain accurate modeling method for antenna design is the need for accuracy and ease in designing a form. So desperately needed a good simulator and complete. From this modeling method, it can be obtained parameter values that are important in the design of the antenna such as Gain, VSWR, radiation pattern, and other parameters. For our research, we use the software simulator CST Microwave Studio

We know that the analog television is often using a monopole antenna or yagi antennas. So it would be very advantageous if only the television device does not use a conventional antenna as usual. Microstrip antenna is considered more efficient because it is easier to be researched and cheaper. But still it is very difficult to obtain a good gain in microstrip antenna. [3],[4],[5]

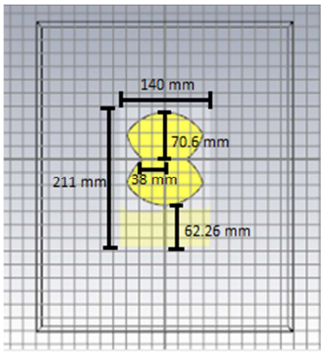

Figure 2. *Front view of antenna design.*

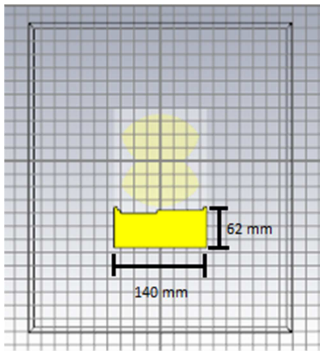

Figure 3. *Back view of antenna design.*

At first, the substrate is made in advance with a length of 211 mm and a width of 140 mm. Then proceed to make a patch that is placed in the middle of the substrate. This step use 2 pieces of a circle witha radius of 60 mm in separate upper and lower positions. Now create a third circle with a radius of 70.6 mm which is placed in the middle of the previous circles. Thus, the patterns of the three circles is the middle part are colliding. Until obtained form such a propeller of a plane. The last step, create a transmission line with a width of 3.372 mm and a height of 62.75 mm.

Once the patch is finished to design, the next step is to design the groundplane on the opposite side of the patch. Groundplane is designed with a length of 62 mm and a width of 140 mm. Then at the top of the groundplane is formed in such a way as to resemble stairs. After the patch and groundplane designed, the microstrip antenna design for analog television look like this:

In accordance with a design that has been described, the length and width of the microstrip antenna is 211 mm x 140 mm made of FR-4 material with the dielectric constant is 3.9. Also made shaped propeller microstrip antenna patch as well as limiting the transmission line between the positive and negative poles of the antenna to be made [6], [7], [8], and [10]

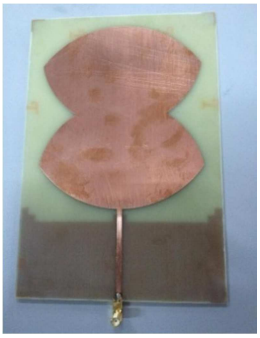

Figure 4. *Front view of the fabrication.*

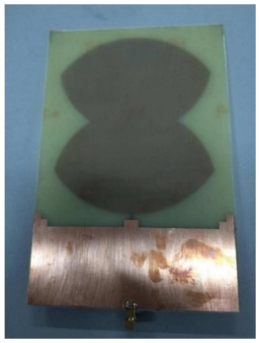

Figure 5. *Back view of the fabrication.*

Simulation Results

- VSWR

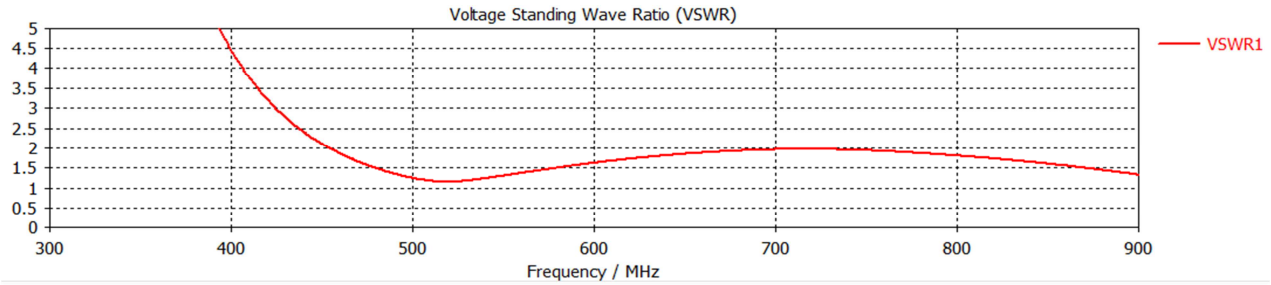

Figure 6. *VSWR.*

Based on the graph, VSWR value at 450-550 MHz frequency is currently close to 1. However when the frequency is between 550-700 MHz , VSWR value jumped up and approaching 2.

- Gain

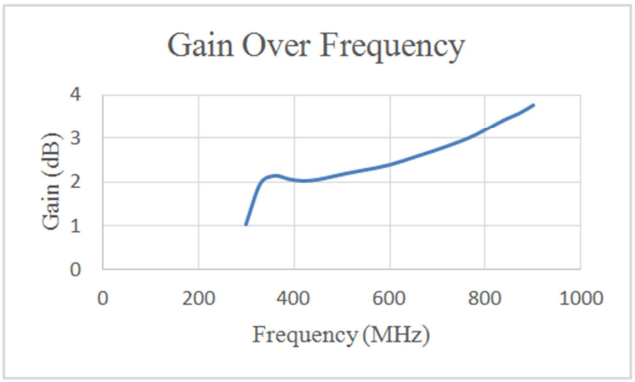

Figure 7. *Gain.*

The simulation results showed that the value of the gain has reached 2 to 2.5dB . This value is sufficient as a required value to make an analog television antenna.

- Return Loss

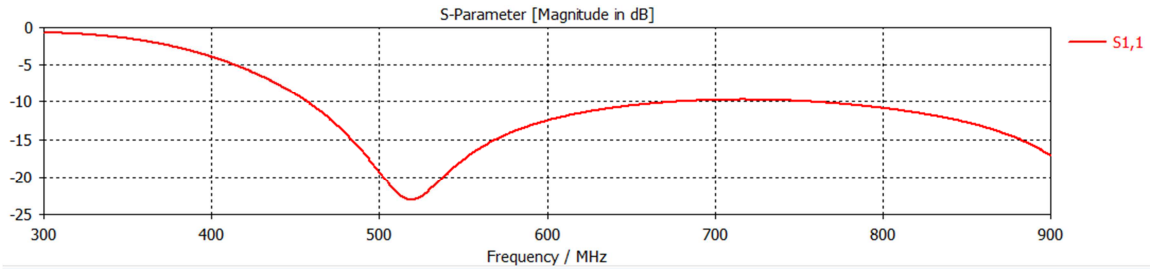

Figure 8. *Return loss.*

The figure 8 shows the return loss at operating frequency (450-750 MHz) is worth from -10 to -20 dB. But the return loss value reached its lowest point in the frequency of 520 MHz.

- Impedance

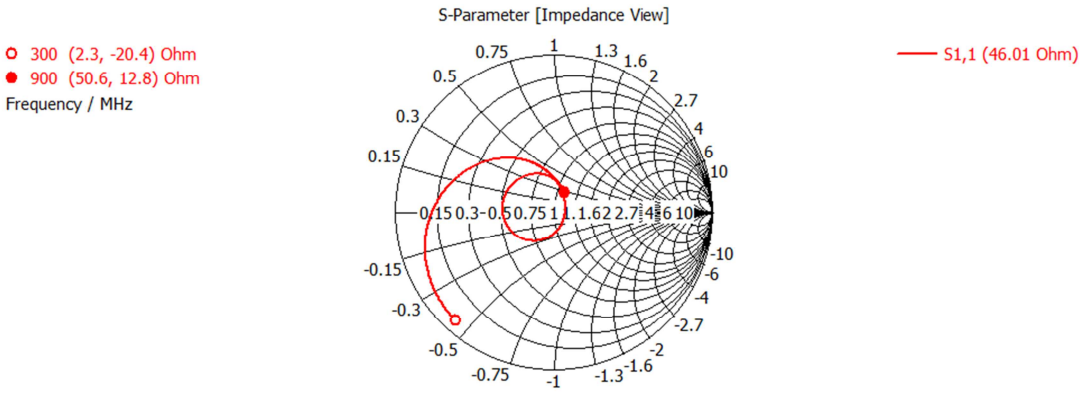

Figure 9. *Impedance.*

The smithchart above shows that the average impedance is 46.01 ohm. It means the antenna can use a cable with 50 ohm impedance which has closer value.

Measurement Results

- Power Accepted

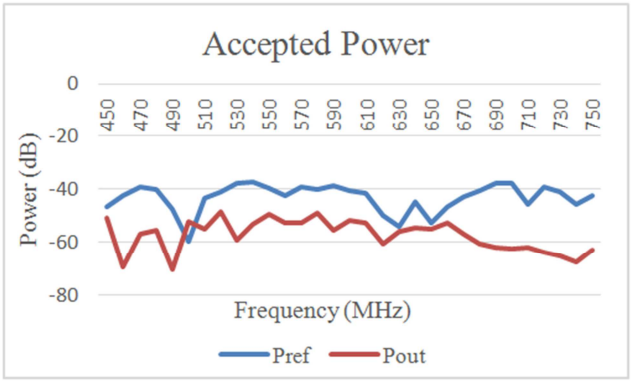

Figure 10. *Accepted Power.*

This antenna design can reduce losses. The majority of the delivered power to the antenna is radiated. From the graph above we can conclude that the antenna radiates better than the reference. But there are some power values that intersected. The errors can occur because of several factors in the measurement.

- Polarization

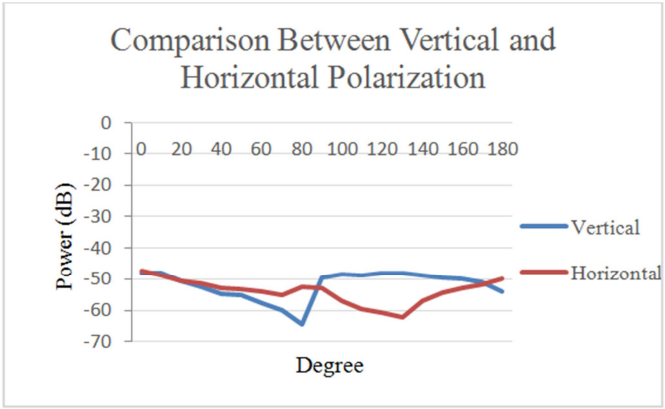

Figure 11. *Polarization.*

The graph above shows that the antenna's power is only strengthened only on the two sides both vertically and horizontally. It means the antenna has linear polarization.

- Radiation Pattern

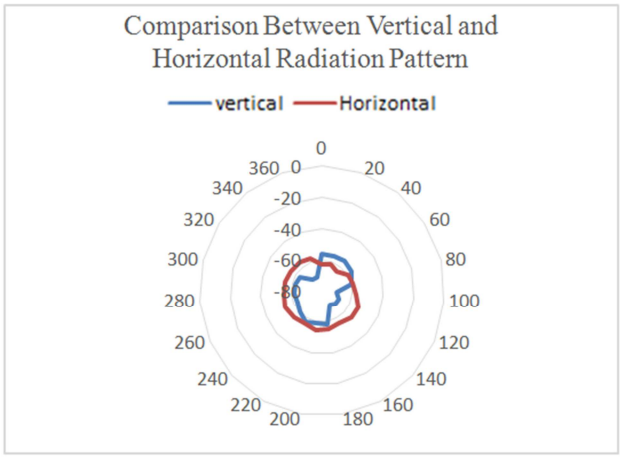

Figure 12. *Radiation Pattern.*

This comparison is viewed from vertical and horizontal side. When it viewed from vertical side, the antenna has omnidirectional radiation pattern. And when it viewed from horizontal side, the antenna has omnidirectonal pattern too, but has almost same values in all direction.

Conclusion

An analog television microstrip patch antenna has been presented. The antenna has been designed and constructed for terrestrial analog TV reception. The designed has been done using simulation from CST Studio Suite 2012. The new antenna has shown good performance in terms of gain and radiation pattern. There is good agreement between design simulation and experimental measurement results, providing validation of the design procedure. The antenna will be useful as analog TV indoor antenna.

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