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DESIGN MICROSTRIP ANTENNA 900 MHZ WITH CUSTOMIZED FLOWER SHAPE PATCH

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ABSTRACT

This research will explain the design of microstrip antenna with 900 MHz frequency that can be applied to all device which worked on these frequency. The design of this antenna begins with theoretical calculations and creating a design based on the results of calculations using CST and then fabricated and be measured using a device GWinstek GSP-827 and IFR Signal Generator 250 kHz-3GHz.

Keywords: antenna, microstrip, customized flower shape patch.

INTRODUCTION

The performance of a telecommunication system depends on the signal-to noise ratio (SNR) at the receiver's input. However, the received signal power is meaningless unless compared with the power received from unwanted sources. Random noise appears in across the terminal of receiving antenna; this noise comes from two sources. Thermal noise generated in antenna's ohmic resistance and noise rece. Microstrip is a microwave antenna that used as a radiator on a number of today's modern telecommunications systems. Some of the advantages of microstrip antenna compared with the other types of antennas, it's thin and small, relatively simple on manufacture, has a light weight, easy to fabricated, can generate a linear polarization and circular polarization using only the rationing that is simple, easy to integrate with other electronic devices, and the cost is relatively cheap [1].

However, this microstrip antenna also has some disadvantages, such as low gain, low bandwidth, and low efficiency and surface wave. This surface wave is usually not desirable because it reduces the power available for radiated into the air [2].

ANTENNA ANALYSIS

Before determining the radiating element, then the first of all must determine the resonant frequency (Fr) was used. Resonance frequency in "flower shape" microstrip antenna works on 900 MHz. So the working frequency is from 800 MHz to 1.1 GHz, due to 900 MHz is the center frequency of the frequency limits. So we could calculate the value to determine the dimension antenna.

$$\lambda_0 = \frac{c}{f_r} = \frac{3 \times 10^8}{900 \times 10^6} = 0.333m = 333\ mm$$

After $\lambda_0$value is obtained, then the wavelength of the microstrip transmission can be calculated by the equation:

$$\lambda_d = \frac{\lambda_0}{\sqrt{\varepsilon_r}} = \frac{333}{\sqrt{4.3}} = 160.590\ mm$$

Dimensions of circular patch can be calculated using equation (1):

$$\text{Rp} = \frac{F}{\left\{1 + \frac{2h}{\pi\varepsilon_r F}\left[\ln\left(\frac{\pi F}{2h}\right) + 1.7726\right]\right\}^{1/2}} \quad (1)$$

$$F = \frac{8.791 \times 10^9}{f_r\sqrt{\varepsilon_r}} = F = \frac{8.791 \times 10^9}{900 \times 10^6\sqrt{4.3}} = 4.71$$

Thus obtained the radius of patch (Rp):

$$Rp = \frac{1.85}{\left\{1 + \frac{2 \times 1.6 \times 10^{-3}}{3.14 \times 4.3 \times 4.71}\left[\ln\left(\frac{3.14 \times 4.71}{2 \times 1.6 \times 10^{-3}}\right) + 1.7726\right]\right\}^{\frac{1}{2}}}$$
$$= 4.708\ cm$$
$$= 47.08\ mm$$

Dimensions ground plane can be calculated using equation [2]:

$$L_g = 6h + 2R \quad (2)$$

$$= (6 \times 1.6 \times 10^{-3}) + (2 \times 47.08 \times 10^{-3}) = 103.6\ mm$$
$$W_g = 6h + \frac{\pi}{2}R$$
$$= (6 \times 1.6 \times 10^{-3}) + \left(\frac{\pi}{2} \times 47.08 \times 10^{-3}\right) = 83.5\ mm$$

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Dimensions transmission line can be calculated using the equation (3):

$$W = \frac{2h}{\pi}\left\{\begin{matrix} B - 1 - \ln(2B-1) \\ + \frac{\varepsilon_r - 1}{2\varepsilon_r}\left[\ln(B-1) + 0.39 - \frac{0.61}{\varepsilon_r}\right] \end{matrix}\right\} \quad (3)$$

Where B is calculated using the equation:

$$B = \frac{60\pi^2}{Z_0\sqrt{\varepsilon_r}} = \frac{60 \times 3.14^2}{50\sqrt{3.9}} = 5.99$$

To determine the bandwidth using the following equation (4):

$$W = \frac{2h}{\pi}\left\{\begin{matrix} B - 1 - \ln(2B-1) + \frac{\varepsilon_r - 1}{2\varepsilon_r} \\ \left[\ln(B-1) + 0.39 - \frac{0.61}{\varepsilon_r}\right] \end{matrix}\right\} \quad (4)$$

$$= \frac{2 \times 1.6}{3.14}\left\{\begin{matrix} 5.99 - 1 - \ln(2 \times 5.99 - 1) + \frac{3.9 - 1}{2 \times 3.9} \\ \left[\ln(5.99 - 1) + 0.39 - \frac{0.61}{3.9}\right] \end{matrix}\right\}$$

$$= 1.02\,\{4.99 - 2.4 + 0.37[1.61 + 0.39 - 0.16]\}$$

$$= 1.02\{2.59 + 0.8\} = 3.46\ mm$$

And for the length of microstrip transmission line is calculated using the equation:

$$L = \frac{1}{4}\lambda_d$$

$$= \frac{1}{4} \times 0.16059\ m$$

$$= 0.0401\ m$$

$$= 40.1\ mm$$

ANTENNA DESIGN

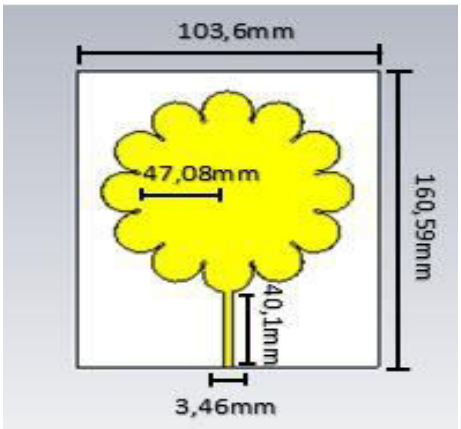

Figure-1. Front view of the proposed antenna.

Figure-1 shows the front view of a microstrip antenna with the length of the substrate is 160.59 mm and the width is 103.6 mm. the length of transmission line is 40.1 mm and the bandwidth is 3.46 mm. then the radius of circle patch is 47.08 mm.

The shape of the antenna design in this research was inspired by the shape of flower so we adding some circles around the patch to decorate.

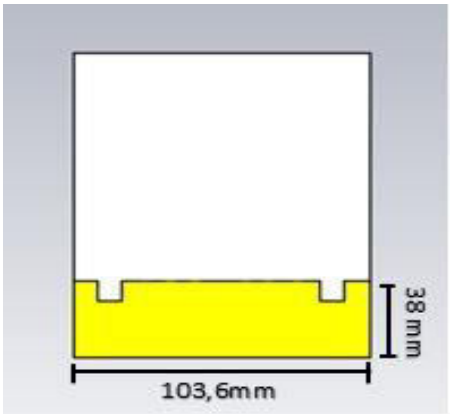

Figure-2. Rear view of proposed antenna.

Figure-2 show the rear view of a microstrip antenna with the length of the groundplane is same as the substrate 103.6 mm and the width is 38 mm after optimization. We adding some shapes in the ground plane for decorate.

Figure-3. Front view of fabrication.

Figure-4. Rear view of fabrication.

SIMULATION RESULTS

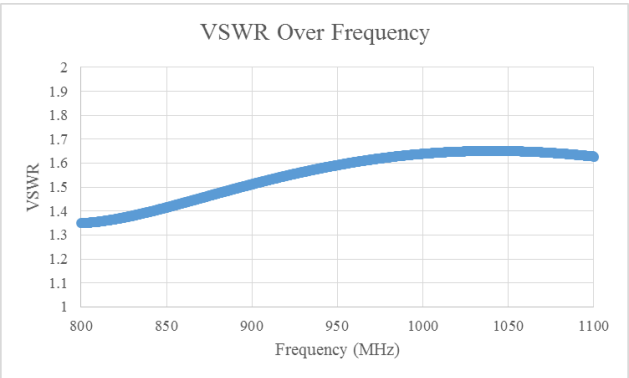

Figure-5. VSWR of simulation result.

From the Figure-5 is obtained VSWR on the frequency 900 MHz is 1.5113. A good VSWR value is between 1 and 2. The more value closer to 1 the better the antenna reflection coefficient is. This shows the antenna reflection coefficient is good enough.

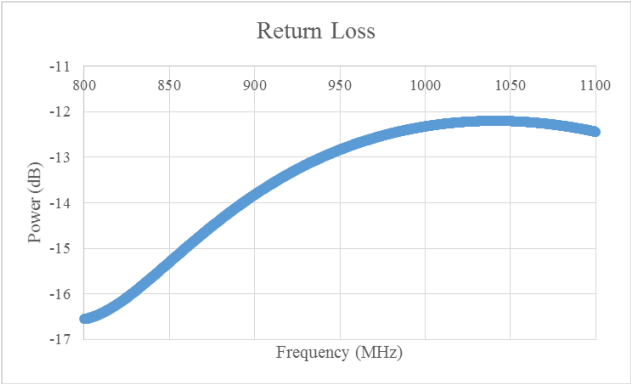

Figure-6. Return loss of simulation result.

The value of the good return loss is below -9.54 dB and from Figure-6 obtained the return loss of antenna is -13.82 dB, which means good.

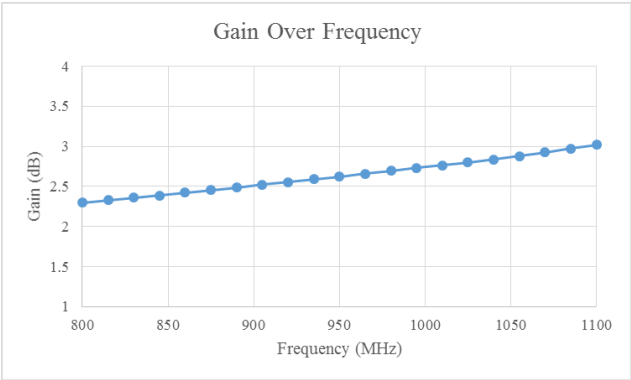

Figure-7. Gain of simulation result.

From the Figure-7 obtained the gain at 900MHz is 2.50822 which means passable.

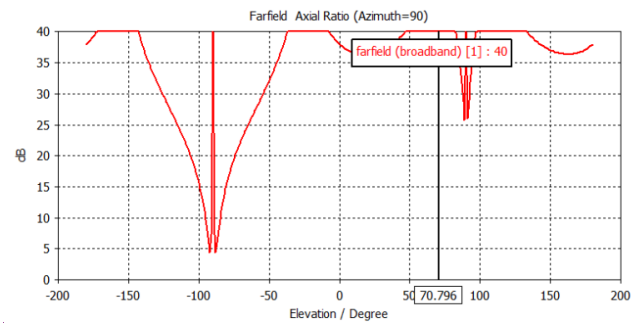

Figure-8. Axial ratio of simulation result.

Axial ratio least than 3dB means has a circular polarization [3]. So from the Figure-8 we can conclude the antenna has linear polarization.

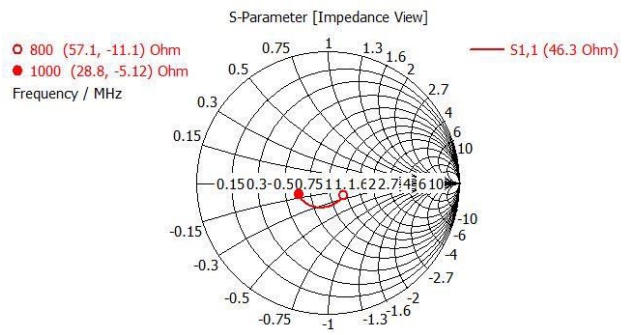

Figure-9. Impedance smith chart of simulation result.

From the Figure-9 obtained average impedance is 46.3 Ohm so the antenna can use a cable that has an impedance of 50 ohms which has closer value.

RESULTS AND ANALYSIS

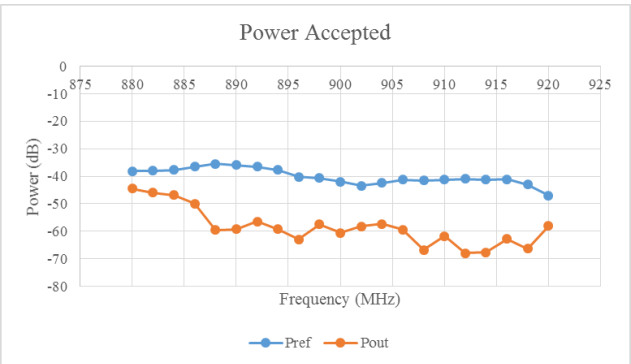

Figure-10. Power accepted of simulation result.

This accepted power is either radiated or absorbed as losses in the antenna. Since antennas are typically designed to be low loss, ideally the majority of the power delivered to the antenna is radiated. From the Figure-10 we can conclude that the antenna radiates better than the reference antenna.

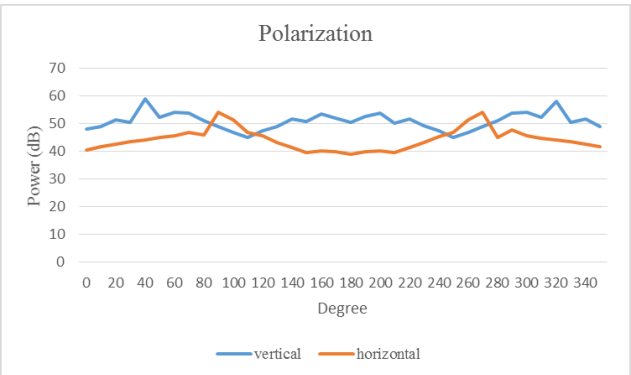

Figure-11. Polarization of simulation result.

From the Figure-11 that the power antenna known only strengthened only on the two sides both vertically and horizontally. So it can be concluded the antenna has linear polarization.

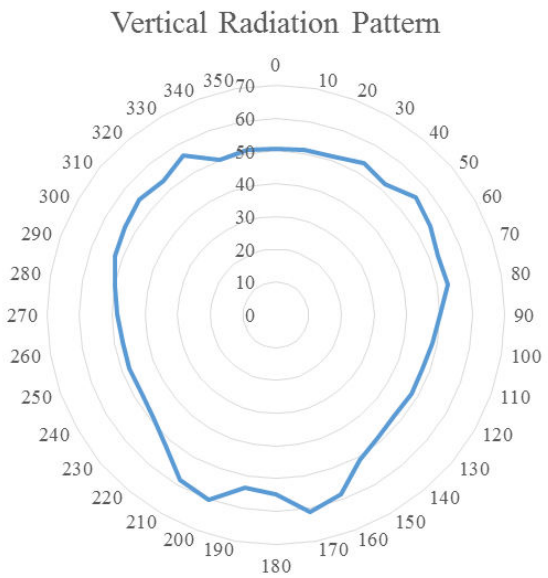

Figure-12. Vertical radiation pattern result.

When it is viewed from a vertical side, this antenna has omnidirectional radiation pattern which has radiation power almost the same value in all directions.

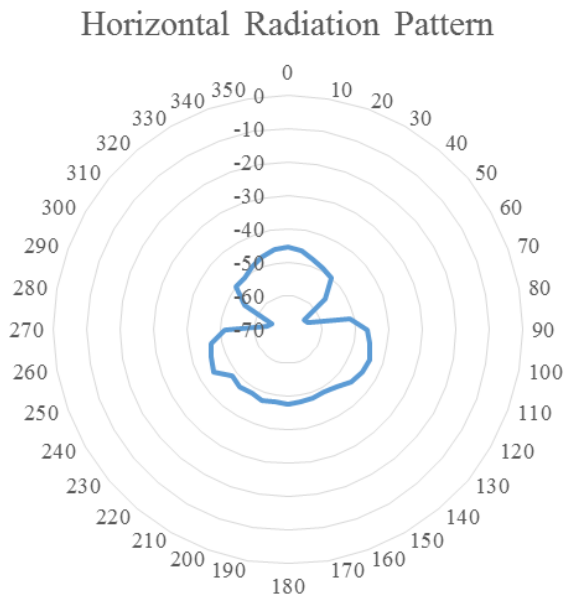

Figure-13. Horizontal radiation pattern result.

When it is viewed from the horizontal side, antenna has omnidirectional radiation pattern as well.

CONCLUSIONS

In the paper has designed a microstrip antenna using flower shape patch with adding some shapes for slot in the ground plane. In the simulation results obtained VSWR < 2 at 900 MHz, RL < -10, gain > 2dB, Axial ratio >3dB which mean has linear polarization.

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