Design of Two Element Microstrip Antenna Array for GSM Applications

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***Abstract* - In this paper microstrip antenna array for GSM applications is presented. Design simulation and optimization processes are carried out with the HFSS simulator. Microstrip antenna design aim is to increase the reach of cellular devices using the GSM system because there are still areas in Indonesia that have not been reached by this service. This antenna is made with an epoxy substrate material that has a dielectric constant and thickness. This antenna uses a microstrip feed channel to send information signals from radiating components to cellular devices. The gain of these antennas is simulated and found adequate and simulated results of the resonant frequency return loss, radiation patterns are presented.**

Keywords- Antenna, Microstrip antenna, antenna array, corporate feeding, HFSS.

I. INTRODUCTION

Any wireless or radio communication system's fundamental component, the antenna, is a gadget with the capacity to transmit and receive electromagnetic energy. An antenna is a device that emits or receives radio waves, according to the IEEE StdI45-1983 definition of the term.

More specifically, an antenna at the transmitting end converts an information signal into electromagnetic energy and transmits it through empty space as a medium, and an antenna at the receiving end receives the electromagnetic wave as a result of an information signal being converted, a process known as transduction. In the former text, the transition from directed wave transmission to unguided energy in free space is described. At the receiving end, the reverse process is carried out without the need of any intermediary devices. The electromagnetic spectrum may be used to determine the frequencies used for this communication.

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Fig 1.Basic Antennas

II. MICROSTRIP ANTENNA

Low-profile antennas are micro strip antennas. A microstrip or patch antenna is made out of a metal patch positioned at ground level with a dielectric substance between. These antennas are quite small and emit very little radiation. At frequencies above 100MHz, patch antennas are used for low-profile applications.

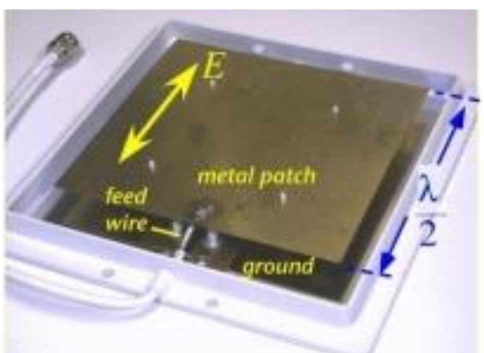

Fig 2. Microstrip Antenna

A extremely thin metallic strip is sandwiched between a ground plane and a dielectric substance to form a micro strip antenna. Photo-etching is used to install the radiating element and feed lines on the dielectric material. For simplicity of analysis and manufacture, square, circular, or rectangular shapes are typically utilized for patches and micro-strips. A microstrip or patch antenna is depicted in the figure below. The metal patch measures λ/2 in length. The energy that is emitted from the edges of the metal patch when the antenna is activated is very low due to reflections that the waves created within the dielectric go through.

II.1 ANTENNA ARRAY

An antenna may emit a certain amount of energy in one direction when used alone, which improves transmission. If a few additional components are added to the antenna, the output will be more efficient. Exactly this concept inspired the development of antenna arrays. The following photos can be used to better understand an antenna array. Check out the connections between the antenna arrays.

Convolutional kernels are a group of filters that make up each convolutional layer. The kernel is the same size as the filter, which is an integer matrix applied to some of the input pixel values.

To make things simpler, each pixel is multiplied by the kernel value that corresponds to it, and the result is then summed to form a single value that, much like a pixel, represents a grid cell in the output channel/feature map. A subtype of affine functions, convolutions are all linear transformations. RGB images with three channels are frequently utilised as computer vision input.

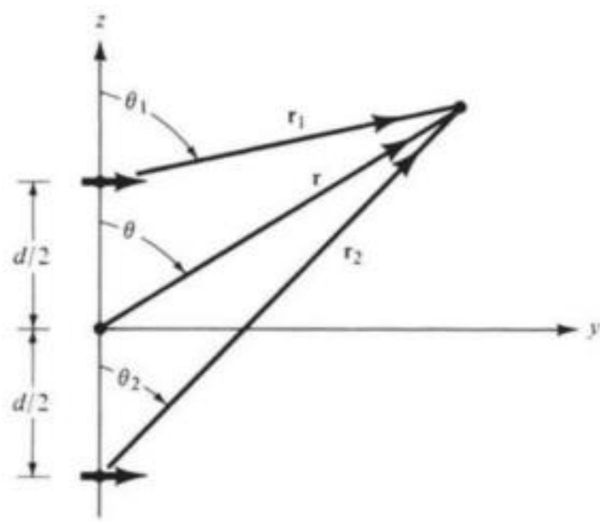

Fig 3.Antenna Array

III. ANTENNA DESIGN

The proposed rectangular patch antenna's planned dimensions are Lg=9.5cm, Wg=18cm, while the patch's length is Lp=3.9cm, Wp=5cm. Corporate feed network is used to create a two element micro strip patch antenna array. The configuration of the two element micro strip patch array

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antenna for GSM application is shown in Figure. In order to improve the antenna performance, 2 patch elements are utilised here, each of which has the same dimensions as those indicated previously.

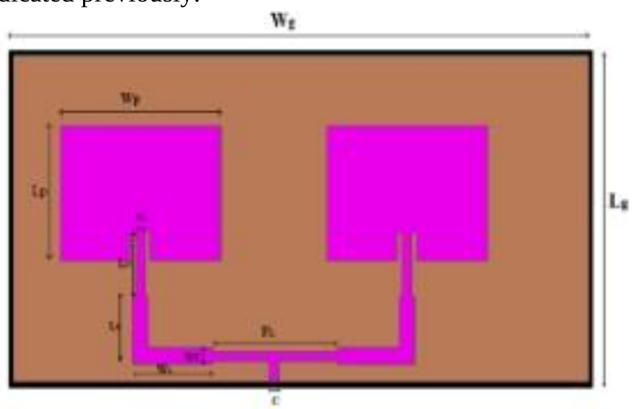

Fig 3. Design view of 2 element MSA

NAME	DIMENSIONS(CM)
Wg	18
Lg	9.5
Wp	5.0
Lp	3.9
WIF	0.3
LIF	2.0
Ls	2.0
Ws	2.0
WF	0.5
FL	3.9
C	0.3

Table 1- Dimesions of 2 element MSA

IV. RESULTS

1. S-PARAMETER PLOT FOR RETURN LOSS

For a rectangular micro strip array antenna with two elements, the S parameter has been calculated. The minimal return loss at 1800 MHz can be seen in the diagram. Additionally, it can be enhanced by introducing a cut mark or slot mark, which increases return loss. The effect is better described in the diagram.

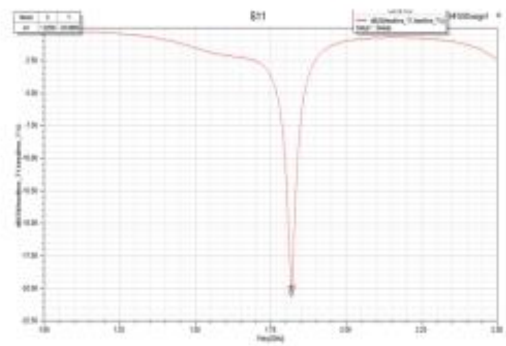

fig 4. S parameter for two element MSA

2. VSWR GRAPGH

VSWR calculation has been done for a rectangular micro strip array antenna with two elements as shown in this figure.

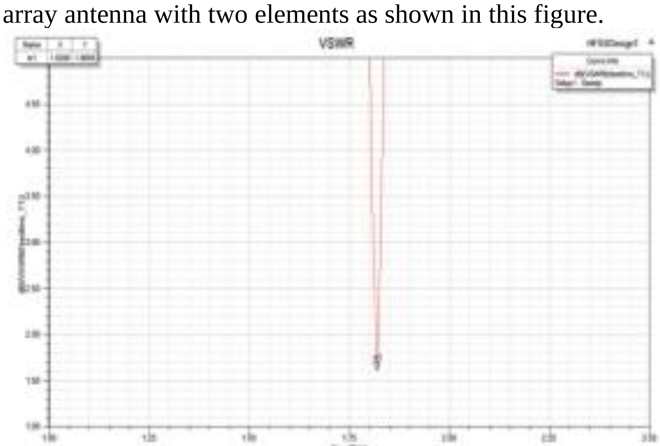

Fig 5. VSWR graph of 2 element MSA\

3. ANTENNA PARAMETERS

Here is a list of some antenna parameters, including gain, directivity, and efficiency. The table makes it evident that a two element array antenna has almost twice the gain and directivity of a single patch antenna.

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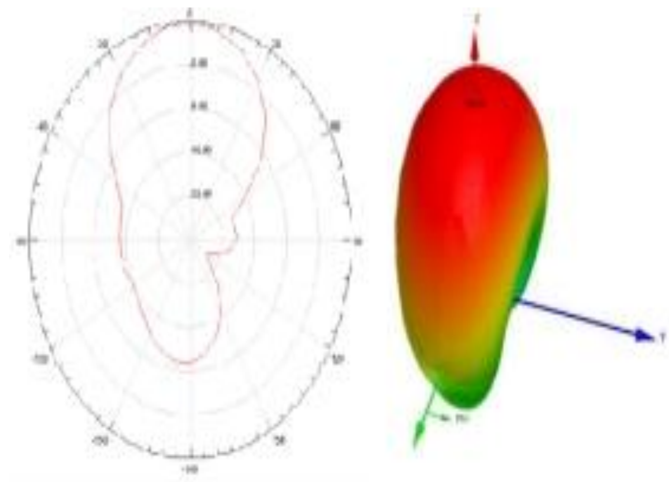

Fig 6. Radiation pattern and 3D polar plot of 2 element MSA

The two element array antenna's gain and directivity are displayed below: The radiation pattern and 3D polar plot taken for all values of phi is depicted in the diagram.

Quantity	Frequency	Value
Max U	1.8GHz	2.135mW/st
Peak Directivity		7.5834
Peak Gain		2.948
Peak Realized Gain		2.6841
Radiated Power		3.5394mW
Accepted Power		9.1769mW
Incident Power		10mW
Radiation Efficiency		0.38569
Front and Back Radiation		32.649
Decay Factor		0

Table 2- Antenna Parameters

V. Conclusion

The antenna in general provides a clear explanation of the benefits and drawbacks of microstrip antennas, as well as the many methods employed when feeding data from the source along with a breakdown of the feeding procedure.
In this paper, we use High Frequency Structure Simulator (HFSS) software to develop slot patch antennas for various materials at various thicknesses (mm), employing various substrate materials (with varied Er) and feed positions. It was known how antennas functioned generally. The design and application's key parameters, including Return Loss, were examined, and their consequences were comprehended. For improved bandwidth, this project uses a variety of materials for the substrate thickness. Every material has an optimal bandwidth (%) for varying substrate thickness at a particular thickness. We used Fr4-EpoxyTM (dielectric) for the slot.

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