Design of Microstrip Patch Antenna using Ads Tool

Rajaneesh Ganiger[1],Nanda Hunagund[2], Shruti Surangi[3], Suman Patil[4], Sachin Patil[5]
[1,2,3,4]Student,[5]Professor
Department of Electronics & communication Engineering
Smt. Kamala & Sri Venkappa M Agadi College of Engineering and Technology

Abstract: The investigation of microstrip fix reception apparatuses has gained incredible ground as of late. Contrasted and regular receiving wires, microstrip fix radio wires have more preferences and better prospects. They are lighter in weight, low volume, minimal effort, low profile, littler in measurement and simplicity of creation and congruity. Also, the microstrip fix recieving wires can give double and roundabout polarizations, double recurrence operation, recurrence deftness, expansive band-width, encourage line adaptability, pillar filtering omnidirectional designing. In this paper we examine the microstriprecieving wire, sorts of microstrip radio wire, nourishing strategies and utilization of microstrip fix reception apparatus.

Keywords:*ADS(Advanced design system), VFH, UFH,MMIC.*

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I. Introduction

This document contains the final report ofdesigning and implementation of a patchantenna, among setting up of dimensions, comparing results from Momentum Microwave and real measurements, analyzing S11 parameters and others. At the beginning it intends to explain what an antenna is. Then, types of antenna and characteristic of patch antenna will be presented. This paper contains also tools and methods which have been used to design the specified antenna. Program that was used to designing process is Advance Design System shared by Universitat Politècnica de Catalunya. Last index gives general information about designed antenna, simulation result, measurements, problems and final conclusion. At the end of document bibliography is attached.

II. Antennas

2.1. What an antenna is?

Piece of wire is not antenna even ignore that in this wire is flowing current generated by hundreds or thousands transmitters placed in some closearea. In other side, when we plug in this wire to radio working on VHF and when it fulfill expectations also make better receiving, then our wire become a antenna.

2.2. Types of antennas

Now will be introduce and briefly discuss some forms of the various antenna types.

2.2.1Wire antennas

Wire antennas are familiar to the layman because they are seen virtually everywhere on automobiles, buildings, ships, aircraft, spacecraft, and so on. There are various shapes of wire antennas such as a straight wire (dipole), loop, and helix. Loop antennas need not only be circular. They may take the form of a rectangle, square, ellipse, or any other configuration. The circular loop is the most common because of its simplicity in construction.

2.2.2 Microstrip antennas

Microstrip antennas became very popular in the 1970s primarily for space borne applications. Today they are used for government and commercial applications. These antennas consist of a metallic patch on a grounded substrate. The metallic patch can take many different configurations. However, the rectangular and circular patches are the most popular because of ease of analysis and fabrication, and their attractive radiation characteristics, especially low cross-polarization radiation. The microstrip antennas are low profile, conformable to planar and nonplanar surfaces, simple and inexpensive to fabricate using modern printed-circuit technology, mechanically robust when mounted on rigid surfaces, compatible with MMIC (Monolithic Microwave Integrated Circuit) designs, and very versatile in terms of resonant frequency, polarization, pattern, and impedance.Theseantennas on surface of high-performance aircraft, spacecraft, satellites, missiles, cars, and even handheld mobile telephones.

2.3. Patch antennas

In high-performance aircraft, spacecraft, satellite, and missile applications, where size, weight, cost, performance, ease of installation, and aerodynamic profile are constraints, low-profile antennas may be required. Presently there are many other government and commercial applications, such as mobile radio and wireless communications, that have similar specifications. To meet these requirements, patch antennas (microstrip, copolar, etc.) can be used. These antennas are low profile, conformable to planar and nonplanar surfaces, simple and inexpensive to manufacture using modern printed-circuit technology, mechanically robust when mounted on rigid surfaces, compatible with MMIC designs, and when the particular patch shape and mode are selected, they are very versatile in terms of

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resonant frequency, polarization, pattern, and impedance. In addition, by adding loads between the patch and the ground plane, such as pins and varactor diodes, adaptive elements with variable resonant frequency, impedance, polarization, and pattern can be designed. Major operational disadvantages of microstrip antennas are their low efficiency, low power, high *Q* (sometimes in excess of 100), poor polarization purity, poor scan performance, spurious feed radiation and very narrow frequency bandwidth, which is typically only a fraction of a percent or at most a few percent. In some applications, such as in government security systems, narrow bandwidths are desirable. However, there are methods, such as increasing the height of the substrate, that can be used to extend the efficiency (to as large as 90 percent if surface waves are not included) and bandwidth (up to about 35 percent). However, as the height increases, surface waves are introduced which usually are not desirable because they extract power from the total available for direct radiation (space waves). The surface waves travel within the substrate and they are scattered at bends and surface discontinuities, such as the truncation of the dielectric and ground plane, and degrade the antenna pattern and polarization characteristics. Surface waves can be eliminated, while maintaining large bandwidths, by using cavities. Stacking, as well as other methods, of microstrip elements can also be used to increase the bandwidth. In addition, microstrip antennas also exhibit large electromagnetic signatures at certain frequencies outside the operating band, are rather large physically at VHF and possibly UHF frequencies, and in large arrays there is a trade-off between bandwidth and scan volume.

2.4 Basic characteristics

Microstrip antennas received considerable attention starting in the 1970s, although the idea of a microstrip antenna can be traced to 1953 and a patent in 1955. Microstrip antennas consist of a very thin (t ≡thickness) ($t \ll \lambda 0$, where $\lambda 0$ is the free-space wavelength) metallic strip (patch) placed a small fraction of a wavelength ($h \ll \lambda 0$, usually $0.003\lambda 0 \leq h \leq 0.05\lambda 0$) above a ground plane. The microstrip patch is designed so its pattern maximum is normal to the patch (broadside radiator). This is accomplished by properly choosing the mode (field configuration) of excitation beneath the patch. End-fire radiation can also be accomplished by judicious mode selection. For a rectangular patch, the length *L* of the element is usually $\lambda 0/3 < L < \lambda 0/2$. The strip (patch) and the ground plane are separated by a dielectric sheet (referred to as the substrate). There are numerous substrates that can be used for the design of microstrip antennas, and their dielectric constants are usually in the range of $2.2 \leq \varepsilon r \leq 12$. The ones that are most desirable for good antenna performance are thick substrates whose dielectric constant is in the lower end of the range because they provide better efficiency, larger bandwidth, loosely bound fields for radiation into space, but at the expense of larger element size. Thin substrates with higher dielectric constants are desirable for microwave circuitry because they require tightly bound fields to minimize undesired radiation and coupling, and lead to smaller element sizes; however, because of their greater losses, they are less efficient and have relatively smaller bandwidths. Since microstrip antennas are often integrated with other microwave circuitry, a compromise has to be reached between good antenna performance and circuit design.

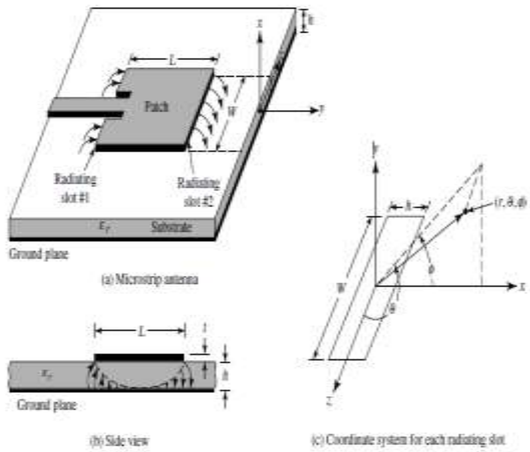

Figure 2.1.Microstrip antenna and coordination system.

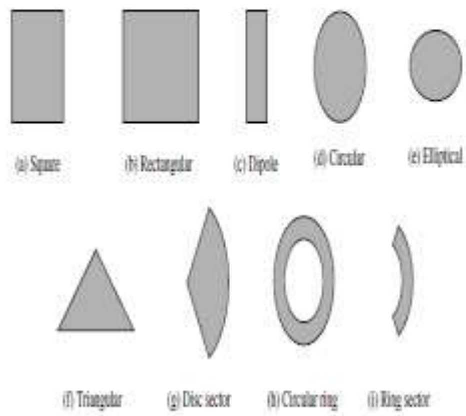

Figure 2.2. Shapes of patch antenna

Often microstrip antennas are also referred to as patch antennas. The radiating elements and the feed lines are usually photo etched on the dielectric substrate. The radiating patch may be square, rectangular, thin strip (dipole), circular, elliptical, triangular, or any other configuration. These and others are illustrated in Figure 2.2. Square, rectangular, dipole (strip), and circular are the most common because of ease of analysis and fabrication, and their attractive radiation characteristics, especially low cross-polarization radiation. Microstrip dipoles are attractive because they inherently possess a large bandwidth and occupy less space, which makes them attractive for arrays. Linear and circular polarizations can be achieved with either single elements or arrays of microstrip antennas. Arrays of microstrip elements, with single or multiple feeds, may also be used to introduce scanning capabilities and achieve greater directivities.

III.Tools and methods

3.1. ADS

We have used Advanced Design System (ADS) as a software in order to made a simulations of antennas. ADS is an electronic design automation software system produced by Agilent EEsof EDA, a unit of Agilent Technologies. It provides an integrated design environment to designers of RF electronic products such as mobile phones, pagers, wireless networks, satellite communications, radar systems, and high-speed data links. Agilent ADS supports every step of the design process—schematic capture, layout, frequency-domain and time-domain circuit simulation, and electromagnetic field simulation—allowing the engineer to fully characterize and optimize an RF design without changing tools. Agilent EEsof has donated copies of the ADS software to the electrical engineering departments at many universities, and a large percentage of new graduates are experienced in its use. Resultthe system has found wide acceptance in industry.

3.2 Momentum Microwave Simulation

Method of moments estimation is based solely on the law of large numbers. Let M1, M2,... be independent random variables having a common distribution possessing a mean μM. Then the sample means converge to the distributional mean as the number of observations increase.

$$\bar{M}_n = \frac{1}{n}\sum_{i=1}^{n} M_i \to \mu_M \quad \text{as } n \to \infty.$$

Momentum is a part of Advanced Design System and gives you the simulation tools you need to evaluate and design modern communications systems products. Momentum is an electromagnetic simulator that computes S-parameters for general planar circuits, including microstrip, slotline, stripline, coplanar waveguide, and other topologies. Vias and airbridges connect topologies between layers, so you can simulate multilayer RF/microwave printed circuit boards, hybrids, multichipmodules, and integrated circuits. Momentum gives you a complete tool set to predict the performanceof high-frequency circuit boards, antennas, and ICs. Momentum Optimization extends Momentum capability to a true design automation tool. The Momentum Optimization process varies geometry parameters automatically to help you achieve the optimal structure that meets the circuit or device performance goals. By using (parameterized) layout components you can also perform Momentum optimizations form the schematic page. Momentum Visualization is an option that gives users a 3-dimensional perspective of simulation results, enabling you to view and animate current flow in conductors and slots, and view both 2D and 3D representations of far-field radiation patterns.

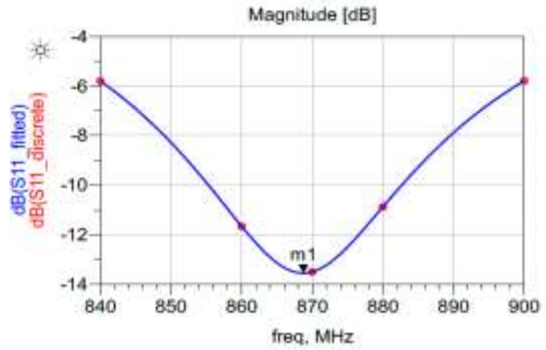

Figure 3.1. S11 parameters

This simulation goes down below -10 dB on right frequency 868 MHz, that means the antenna is correct (fitted). "m1" point is placed on 868 MHz and amount -13.55 dB as shown in Figure3.1 Momentum microwave simulation in ADS was very satisfy. This antenna radiate in almost every direction. Radiation patters shown in figures 3.3 and 3.4. Gain of our antenna is about 0.3 dB, directivity = 2.13 dB,efficiency = 65.65 % and power radiation = 14 mW. From radiation patter is result that is a omnidirectional antenna.

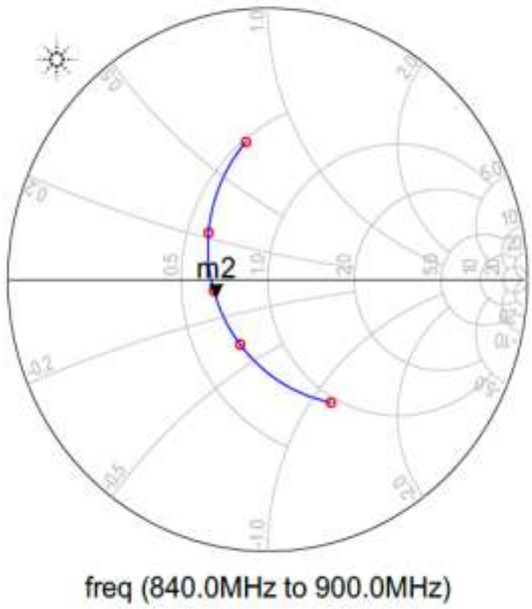

Figure 3.2. Simulated IFA on Smith chart

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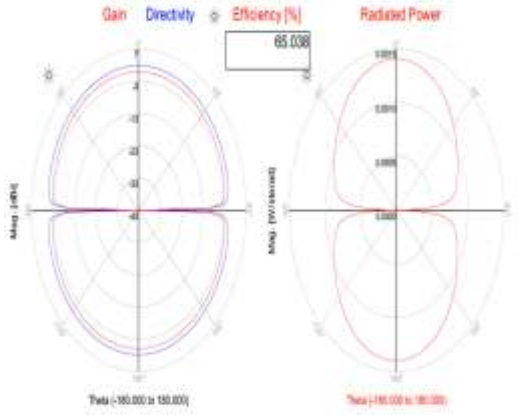

Figure 3.3. Radiation pattern - part 1 φ=0O

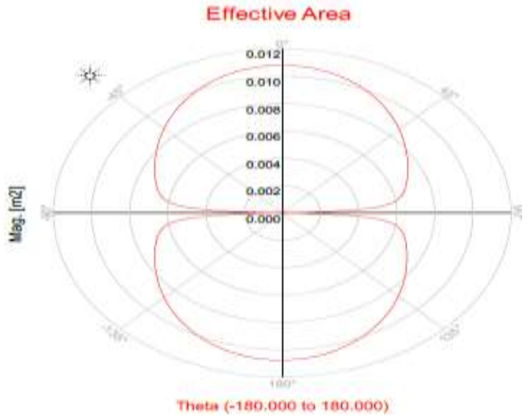

Figure 3.4. Radiation pattern - part 2 φ=0O

IV. Conclusion

To outline all outcomes, instrument to reproduction recieving wire is Momentum microwave from ADS. That reenactment give the most comparative outcomes to created reception apparatus. To match recurrence and to take the best S11 parameters it is important to control length of radiation stripe and microstrip near sustain point. Last outcome are superior to anything a unique idea from TI, which implies in changing model we make progress.

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