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AN OVERVIEW OF MICROSTRIP ANTENNA

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ABSTRACT

A remarkable increase in the field of broadband communication has paved the way for a wide range of micro strip antenna research and applications. Micro strip antennas' flexibility brought a new dimension to it. The introduction and overview of the Micro strip antenna are presented in this research paper. The benefits, disadvantages, and limits of various feeding methods are also addressed. The techniques for modeling a micro strip antenna are also discussed. It also gives a notion of how antennas are classified.patch antenna with microstrips. A patch antenna's design and analytical techniques have been explored. Various patch shapes have been used and explored in relation to the applications. Despite the fact that much work has been done on micro strip antennas, there is still much more to be done. Microwave and millimeter wave technology have advanced to the point that systems can now be miniaturized.

KEYWORDS: *Antenna, Electromagnetic, Microstrip, Probe, Feeding.*

1. INTRODUCTION

A patch antenna (also known as a microstrip antenna) is one of the most recent antenna and electromagnetic applications technologies. Because of its ease of usage and compatibility with printed circuit technology, it is currently extensively utilized in wireless communication systems. In the 1950s, electromagnetic wave-radiating microstripgeometries were first proposed. In 1953, Deschamps [3] presented the idea of a microstrip antenna for the first time. The microstrip was patented by Gutton and Baissinot in 1955. Microstrip lines and radiators were first created in labs as specialized equipment. During this time period, there were no commercially accessible printed circuit boards with controlled dielectric constants. As a result, it wasn't until the 1970s, when Robert E. Munson improved it that this antenna became viable. The availability of low-loss tangent substrate materials sped up development throughout this decade, thanks to the efforts of other researchers. Enhanced photolithographic methods, improved theoretical modeling, and appealing thermal and mechanical characteristics of the substrate are among the other reasons driving the advancement. Munson [6] and Howell [7] were the first to create a workable antenna.

Microstrip antennas and their arrays have seen a wide range of applications since then, thanks to considerable research and development. With the advances in printed circuit technology, microstrip or printed patch antennas are now utilized in virtually all wireless systems. Microstrip or patch antennas are used in wireless communication applications to emit and receive electromagnetic radiation in the microwave range. The geometry of the printed patch [8] as well as the material properties of the substrate onto which the antenna is printed determine the performance and functioning of a microstrip antenna. Microstrip antennas are a recent innovation. It was created to make it easier to combine an antenna and other communication system driving circuits on a single printed circuit board or semiconductor chip (Carver and Mink, 1981; Pozar, 1992). Aside from the aforementioned benefits, the antenna manufacturing using integrated-circuit technology allows for great dimensional precision, which was previously impossible to accomplish using conventional fabrication techniques. A microstrip antenna's geometry is made up of a dielectric substrate with a thickness of d, full metalization on one side, and a metal "patch" on the other. In most cases, the substrate is thin. The metal patch on the front surface may take many different forms, but the rectangular shape is the most typical. Various ways of energizing the antenna are available One popular method is to feed from a microstrip line by attaching the microstrip antenna to one of its edges near the center. The microstrip line may be directly fed by connecting a signal source between the microstrip line and the ground plane, or it can be supplied via a feeding circuit. The broadside (perpendicular to the substrate) of the microstrip antenna generates the most radiation, while the end-fire (along the substrate's surface) produces the least. The antenna's size is typically chosen such that it resonates at the working frequency, resulting in a real input impedance. This necessitates a rectangular microstrip antenna with a length of approximately half a wavelength in the dielectric medium.

On the other side, the width of the antenna, W, affects the input impedance level. A rectangular chamber with open sides is what a microstrip antenna looks like[1]. The radiation is caused by the fringing fields that pass through the open sidewalls. The structure, however, is mostly a resonant cavity with relatively little fringing radiation. As a result, the radiation's bandwidth is low when compared to the bandwidth of the antennas mentioned previously. The limited bandwidth, on the other hand, is sufficient for a wide range of communication applications. For some analytical modeling of a microstrip antenna, see Balanis (1997) and Carver and Mink (1981).Rectangular and circular patches are the most frequently utilized microstrip antennas. These patches are suitable for both basic and complex applications. Dual-frequency operations, circular and dual polarizations, wide bandwidth, beam scanning, and other features may be readily achieved with these patches. By initially applying any new numerical or analytical method to these geometries, any new numerical or analytical approach is standardized. The rectangular microstrip patch antenna is without a doubt the most basic micros trip antenna design[2]. As a result, this article is on rectangular micros trip antennas. A Micro strip patch antenna in its most basic form comprises a radiating patch on one side of a dielectric substrate and a ground plane on the other, as.

A micros trip antenna is a dielectric substrate panel wedged between two conductors in its most basic form. Ground plane refers to the bottom conductor, whereas patch refers to the top conductor. Micro strip antennas are often employed at frequencies ranging from 1 GHz to 100 GHz[3]. The patch has been chosen to be very thin. Patches are often made of gold or copper and come in a variety of forms. Because of their low resistivity, resilience to oxidation, simplicity of soldering, and ability to attach effectively to substrates, these conducting metals are the most popular. On the dielectric substrate, the feed line and radiating patch are etched. The radiating patch may be designed in a variety of forms depending on the required features, but owing to their simplicity of manufacturing and analysis, circular, square, and rectangular designs are the most popular. Despite the differences in geometrical form, their radiation properties are identical because they function like a dipole. Surface waves and spurious feed radiation rise as the thickness of the dielectric substrate increases, reducing the antenna's bandwidth. Unwanted cross-polarized radiation is also produced by the feed radiation. The fringing fields between the patch's borders and the ground plane are what cause microstrip patch antennas to emit. For improved performance, a thick dielectric substrate with a low dielectric constant is preferred. This will increase efficiency and reduce radiation[4]. However, this feature has a tendency to increase the antenna's size. The substrate dielectric constants should be high in order to create a compact form. Such a design, on the other hand, will be less efficient and have a smaller bandwidth. Impedance matching between the antenna and the feed line is needed to guarantee maximum energy transmission from the source to the radiating components[5]. The antenna and feed line will be matched at a port position that is roughly chosen. After decades of study, it was discovered that the geometry of the printed patch and the material properties on which the antenna is printed control the performance and operating of a microstrip antenna[4]. Although rectangular patches are the most common, square, circular, and triangular patches are all conceivable.The radiating element may be square, rectangular, triangular, elliptical, or circular in form, depending on the properties of the transmitted electromagnetic radiation, and must be distanced from the ground plane by a defined distance. Between these two conducting layers is a strip of dielectric substrate.

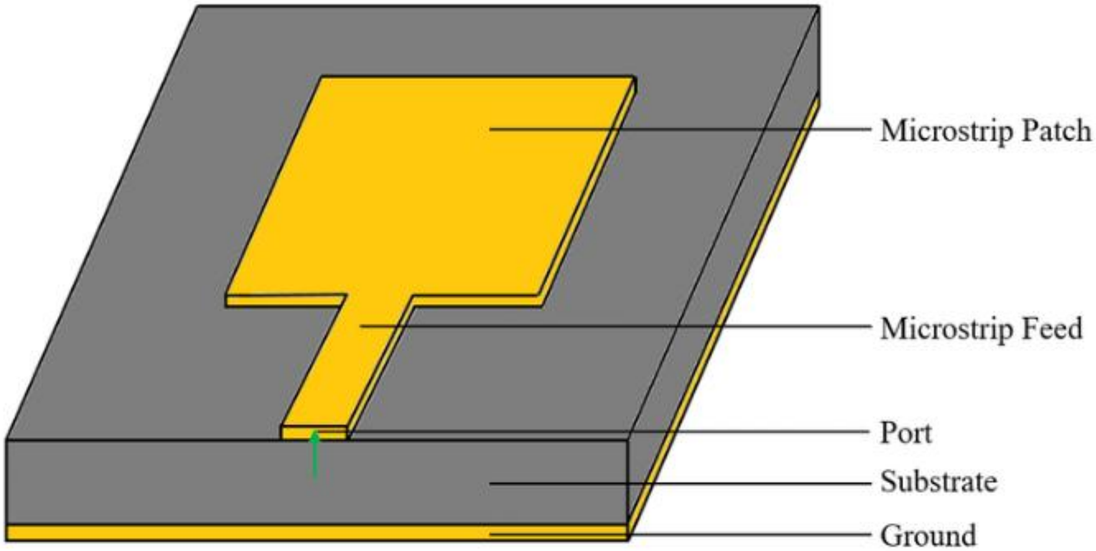

Figure 1: Diagrammatic Representation of [PROFILE]

1.1 Application of Microstrip Antenna

The usage of micro strip or printed patch antennas may meet a variety of commercial needs. Rectangular shaped patch antennas are the most often used antennas out of a variety of forms. Micro strip patch antennas meet the majority of criteria for mobile and satellite communication systems, and several different types of micro strip antennas are available. Other common uses include aircraft, spacecraft, satellites, and missiles, all of which benefit from the micro strip antenna's size, weight, cost, performance, simplicity of installation, and low-profile design. In the field of mobile radio and wireless communications, there are many additional government and commercial uses where this antenna is appropriate. These antennas are used to meet a wide range of business requirements [6]. The omnipresent Global Positioning System (GPS), ZigBee, Bluetooth, WiMAX, Wireless Fidelity (Wi-Fi), and wireless communication technologies are among the many applications. Antennas are in high demand for navigational applications such as automotive asset tracking and maritime applications. In the fields of industry, transportation, and medicine, it is widely used in radio frequency identification (RFID) and radar systems. In summary, micro strip antennas meet the needs of a lightweight, flexible antenna system.

In recent years, satellite digital audio radio services have used printed monopole micro strip antennas as an alternative to audio commercial broadcasts in cars. The benefits of utilizing antennas in communication systems will continue to drive the development of new applications that rely on them[7]. They are the gadget that allows all of the wireless technologies that have grown so common in our culture to function. In many contemporary communication systems, the material costs of cable infrastructure also promote the usage of antennas. The number of applications will continue to expand as people become more aware of the capabilities of Microstrip antennas, especially owing to their radiation mechanism and functional performance[8]. Certain applications in communications, electronic support and countermeasures, radar, and radiometry require a large bandwidth.

Some common application of Microstrip antenna:

- Satellite Communication Direct Broadcast Service.
- Mobile Communication Systems
- Radars such as Doppler and others
- Missiles and telemetry are the fourth and last items on the list.
- Environmental Instrumentation and Remote Sensing
- Receivers for satellite navigation.
- A radio altimeter is a device that measures the altitude of an object.
- Intruder Alarms and Biomedical Radiators
- Wireless Communication Systems and Services for Individuals.

1.2 Feeding Techniques for Microstrip Antenna:

The feed transports electromagnetic energy from the source to the patched area. Some of this energy escapes the patch's confines and is radiated into space. A number of techniques are used to feed the signal in micro strip patch antennas. Feeding techniques are divided into two categories: contacting and non-contacting. The input radio frequency power is supplied directly to the patch via a connecting device such as a micro strip line in the contacting technique. Electromagnetic field coupling is used in the non-contacting method, which is also known as the indirect scheme, to transmit power between the micro strip line and the radiating patch. Micro strip line feed, coaxial feed, aperture coupling feed, proximity coupled micro strip feed, and coplanar waveguide feed are the four most common feeding methods[9]. The bandwidth, radiation pattern, polarization, gain, and impedance of an antenna are all influenced by the feeding technique. The coaxial and micro strip feeds are the most frequently utilized feeding methods in practice. Because the antenna and feed lines' input impedances vary from the standard 50-ohm line impedance, matching is typically needed. The antenna and its feed line will be matched if the port position is chosen correctly. The section below gives a short explanation of each of these feeding techniques[10].

- *Micro strip Line Feed:* Micro strip Line Feedis a kind of micro strip line that is used to A conducting strip is linked directly to the edge of the Microstrip patch in this kind of feed method. In comparison to the patch's size, the conducting strip is narrower. Because the feeding system and radiating patch may be printed on the same dielectric substrate, this technique is the simplest to implement. This configuration creates a flat structure. Edge-fed patches may be used to build huge arrays because of this benefit. The disadvantage is that the feed line radiation causes a rise in the crosspolarlevel. Furthermore, in the millimeter wave area of the spectrum, the feed line dimension is equal to the patch size dimension, resulting in increased unwanted radiation. An inset incision in the patch may be part of the feed arrangement to the patch. The inset cut in the patch's function is to match the feed line's impedance to the patch without the need of any extra matching elements. This is accomplished by carefully managing the inset position. This is a simple feeding system because it allows for straightforward manufacturing, modeling simplicity, and impedance matching.

- *Feeding of the Coaxial Probe:* The most popular method for feeding printed patch antennas is the coaxial feed or probe feed. To accomplish impedance matching, this feed may be supplied at any desired position inside the patch. The inner conductor of the coaxial connection is soldered to the radiating patch via the dielectric, while the outer conductor is attached to the ground plane. Low radiation loss is achieved using the coaxial or probe feed technique. The primary benefit of this feed is that it may be positioned anywhere inside the patch to match its input impedance. This feed technique is simple to make and emits little spurious radiation. However, since a hole must be drilled into the dielectric substrate, it has a significant disadvantage in terms of bandwidth and is difficult to utilize. The hole in the substrate must also be bored, and the connection must extend beyond the bottom ground plane. It is not entirely flat, and the asymmetry of the structure is due to the feeding system. Increased coaxial feed or probe feed length for thicker dielectric substrates makes the input impedance more inductive, causing impedance matching issues. Both of the aforementioned techniques of direct feeding the micros trip antenna have issues with thick substrates, which are often used to produce wide band. Increased probe length makes the input impedance more inductive in a coaxial feed, causing the matching issue. An increase in substrate thickness increases the width of the micros trip feed, which increases the unwanted feed radiation. Microstrip line and coaxial feeds suffer from probe reactance and surface wave excitation issues on high thickness dielectric substrates. These issues are solved by the indirect feed, which is described further below.

- *Micro strip Feed withAperture*; The field is linked from the feed line to the resonating patch via a slit in the ground structure that is positioned between the two substrates in an aperture coupling. There is a feed line on the bottom substrate and a radiating patch on the top substrate. The field is coupled from the micro strip line feed to the radiating patch via an electrically tiny aperture or slot created in the ground plane in the aperture coupledmicro strip antenna design. Under the patch, the coupling aperture is usually centered. Because of the configuration symmetry, this helps to reduce cross-polarization. The form, size, and placement of the aperture determine the degree of coupling from the feed line to the patch. There are two types of slot apertures: resonant and non-resonant. The resonant slot adds additional resonance to the patch resonance, thus boosting bandwidth, albeit at the expense of increased back radiation. As a consequence, non-resonant apertures are often used.

- *Proximity-Related Micro Strip Feeding Method*: a non-contacting micros trip feed arrangement utilized a two-layer substrate with the micros trip line on the bottom layer and the patch antenna on the top layer. This feeding technique has two dielectric layers, one of which is a radiating patch layer and the other of which is a feed line with a ground plane on the reverse side. A common ground plane separates the two substrates. Through a slot aperture on the common ground plane, the patch is electromagnetically linked to the micros trip feed line on the bottom substrate. These settings may be utilized to increase bandwidth regardless of the shape or size of the slot. Because of the shielding effect of the ground plane, radiation from the open end of the feed line does not interfere with the patch's radiation pattern. This feature also enhances the purity of the polarization. Due to the symmetry of the arrangement, the coupling aperture is typically centered beneath the patch, resulting in reduced cross polarization. To maximize patch radiation, a thick, low dielectric constant material is utilized for the bottom substrate and a thin, high dielectric constant material is used for the top substrate. Wider bandwidth is a noteworthy characteristic of this feed arrangement, which is mainly due to an increase in the thickness of the micro strip patch antenna. This method allows you to use a different substrate for the patch and the feed line in order to get the best results. The main disadvantage of this technique is the difficulty in manufacturing owing to the numerous layers that must be aligned properly. The antenna thickness rises in this technique as well.

- *Feeding using a Coplanar Wave Guide (CPW)*; The Micro strip antenna has also been excited using the coplanar waveguide feed. The coplanar waveguide is printed on the ground surface of the patch in this manner, as illustrated in Figure 6. A coaxial feed excites the line, which is terminated by a slot that is almost a fourth of the slot wavelength long. Because of its numerous advantages, such as broad band width, simple construction, a single metallic layer, fewer soldering points, and compatibility with other circuits, this feeding technique is extensively employed for wireless communications. The major drawback of this technique is that it produces a lot more radiation due to the larger slot. This may be improved by shrinking the slot dimension and reshaping it into a loop.

2. DISCUSSION

A micros trip antenna (also known as a printed antenna) is an antenna that is manufactured on a printed circuit board using photolithographic methods (PCB). It functions as an internal antenna. Microwave frequencies are where they're most often utilized. An individual micros trip antenna is made up of a patch of metal foil in different forms on the surface of a PCB (printed circuit board) and a metal foil ground plane on the opposite side. The majority of micros trip antennas are made up of numerous patches arranged in a two-dimensional array. Foil micros trip transmission lines are used to link the antenna to the transmitter or receiver. Between the antenna and the ground plane, a radio frequency current is delivered (or, in receiving antennas, a received signal is generated). Due to their thin planar profile, which can be incorporated into the surfaces of consumer products, aircraft, and missiles; their ease of fabrication using printed circuit techniques; the ease of integrating the antenna on the same board as the rest of the circuit; and the possibility of adding active devices such as microwave integrators, micros trip antennas have become very popular in recent decades. Antenna patchPatch antennas are by far the most popular kind of micros trip antenna. Patch antennas may also be used as constituent components in an array. A patch antenna is a narrowband, wide-beam antenna made by etching the antenna element pattern in metal trace attached to an insulating dielectric substrate, such as a printed circuit board, with a continuous metal layer connected to the other side of the substrate that serves as a ground plane. Square, rectangular, circular, and elliptical micros trip antennas are common, although any continuous form is conceivable.

3. CONCLUSION

The article provides a succinct overview of antennas in general and micros trip antennas in particular. It concisely explains the benefits and drawbacks of micros trip antennas, as well as the different methods utilized in source feeding. A short comment about the analytical procedure is included with the explanation of the feeding methodology.patch antenna with micro strips. A patch antenna's design and analytical techniques have been explored. Various patch shapes have been used and explored in relation to the applications. Despite the fact that much work has been done on microstrip antennas, there is still much more to be done. Microwave and millimeter wave technology have advanced to the point that systems can now be miniaturized.

REFERENCES

1. R. Mishra, "An Overview of Microstrip," *Int. J. Technol. Innov. Res.*, 2016.
2. K. F. Lee, "A personal overview of the development of microstrip patch antennas," 2016, doi: 10.1109/APS.2016.7696053.
3. D. M. Pozar, "Microstrip Antennas," *Proc. IEEE*, 1992, doi: 10.1109/5.119568.
4. M. R. Ghuge, A. P. Khedkar, and P. U. Indulkar, "A Comparative Study of Gain Enhancement Techniques for Microstrip Patch Antenna," *Int. J. Eng. Sci. Innov. Technol.*, 2014.
5. M. I. Nawaz, Z. Huiling, M. S. S. Nawaz, K. Zakim, S. Zamin, and A. Khan, "A review on wideband microstrip patch antenna design techniques," 2013, doi: 10.1109/ICASE.2013.6785554.
6. D. Alvarez Outerelo, A. V. Alejos, M. Garcia Sanchez, and M. Vera Isasa, "Microstrip antenna for 5G broadband communications: Overview of design issues," 2015, doi: 10.1109/APS.2015.7305610.
7. M. Polívka, A. Holub, and M. Mazánek, "Collinear microstrip patch antenna," *Radioengineering*, 2005, doi: 10.5772/9396.
8. Z. H. Hu, M. Gallo, Q. Bai, Y. I. Nechayev, P. S. Hall, and M. Bozzettit, "Measurements and simulations for on-body antenna design and propagation studies," 2007, doi: 10.1049/ic.2007.1067.
9. J. L. Gómez-Tornero, A. Alvarez-Melćon, F. Mesa, F. Medina, G. Goussetis, and Y. Jay Guo, "Analysis and design of controllable leaky-wave antennas inspired by Prof. Arthur Oliner a tribute to Prof. Oliner," 2014, doi: 10.1109/EuMC.2014.6986465.
10. K. Bt Lias, M. Z. A. Narihan, and N. Buniyamin, "An antenna with an embedded ebg structure for non invasive hyperthermia cancer treatment," 2014, doi: 10.1109/IECBES.2014.7047577.