

# RECTANGULAR PATCH MICRO STRIP ANTENNA: A SURVEY

Nikita Sharma, Bhawana Jain, Pradeep Singla, Raj Ranjan Prasad

Department of Electronics and Communication, Dronacharya Group of Institutions, Greater Noida, U.P., India

**Abstract:** This paper present a survey on the micro strip patch antenna and there historical perspectives. The micro strip antenna has better prospects and advantages which make greater progress in recent years. In this paper we discuss micro strip antenna, types, feeding techniques and application, advantage and disadvantages over conventional microwave antennas. We also discuss their dual and circular polarizations, dual-frequency operation, frequency agility, broad band-width and feed line flexibility.

**Index Terms:** Micro strip Antenna (MSA), Micro strip patch antenna (MPA)

## I. INTRODUCTION

Antenna is a transducer that converts one form into another and transmits or receives the electromagnetic waves. Micro strip antenna consists of radiating patch on one side of dielectric substrate and ground plane on the other side.

Micro strip antennas printed directly onto a circuit board because of that they are very useful. Radiating patch is made of conducting material (copper or gold) with many different shapes like rectangular, circular, and elliptical and many more shapes.

The rectangular patch antenna is one-half wavelength long of rectangular micro strip transmission line.

The Patch antenna is narrow band and wide-beam antenna. Fabrication of patch antenna done by etching the element pattern in metal trace with a continuous metal layer bonded to the opposite side of the substrate [1].

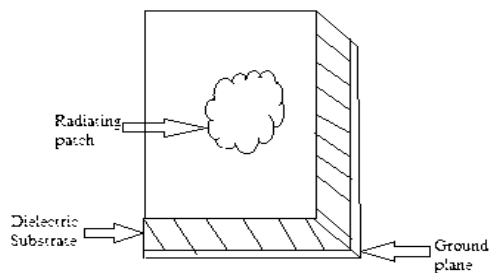


Figure-1: Micro strip patch antenna.

## II. HISTORY OF MICROSTRIP PATCH ANTENNA

Micro strip antenna was introduced by Deschamps in 1950s. Later that many author investigate on it like James hall, David M. Pozar .

Micro strip antennas have larger number of physical parameters and many different geometrical shapes and dimensions. There are four categories:

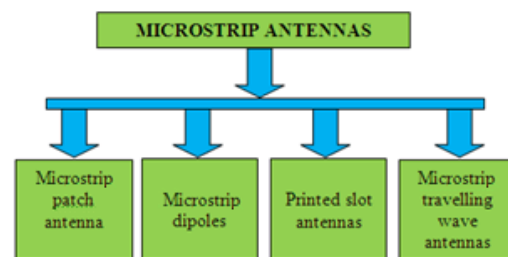


Figure-2: Categories of Micro strip patch antenna

The micro strip patch antennas have dual and circular polarizations, dual-frequency operation, frequency agility, broad band-width, feed line flexibility, and beam scanning Omni-directional patterning [2]. There are U and H slots in rectangular patch is achieved by Dual and triple frequency operation. The bandwidth impedance of the antenna is 150MHz and 1.26GHz band for U slot and 154MHz, 484MHz and 396MHz for H slot [3].

**H- SLOT PATCH ANTENNA:** H-shaped slots formed by cutting three slots from a rectangular patch [4, 5] due to which gain and bandwidth of micro strip antenna enhanced. The size of ground plane is (L X W) 90 X 100 mm and thickness of dielectric substrate is 3.2 mm. This antenna used for circular polarization with single narrow band frequency.

**U- SLOT PATCH ANTENNA:** Simple coupled micro strip antenna with rectangular patch results in single-band antenna. For dual band operation single U-slot is cut in the patch. The size is (L X W) 32 X 40 mm.

The patch substrate thickness is 1.57mm and dielectric constant 4.4. resonant frequency is 3.6 GHz and 5.2 GHz. A single U- slot results in dual band antenna and inserting another U- slot in same patch results in triple band antenna. Both provide satisfying values of gain and directivity[7].

**S- SLOT PATCH ANTENNA:** S- shaped slot cut at the center of a square patch for triple band operation. The frequency ratio of the antenna controlled by adjusting the S-shaped slot arm length. The size is (L X W) 115 X 110 mm and dielectric substrate is 1.06. Antennas provide very high gain and directivity and less frequency ratio[2].

**E- SLOT PATCH ANTENNA[4]:** E- shaped patch provide broadband characteristics. To match the antenna input impedance to the feed line, an open ended stub is used at the end of the feed line. The size is (L X W) 42 X 28 mm. It covers frequency range from 2.40 GHz - 2.86 GHz. The feed substrate and patch substrate are made of dielectric substrate with dielectric constant ( $\epsilon$ ) = 2.2 and thickness of 6.7 mm. Asymmetrical arms of E- shaped patch results in broadband antenna whereas symmetrical arms results in dual band antenna. Both antennas provide very good gain and directivity.

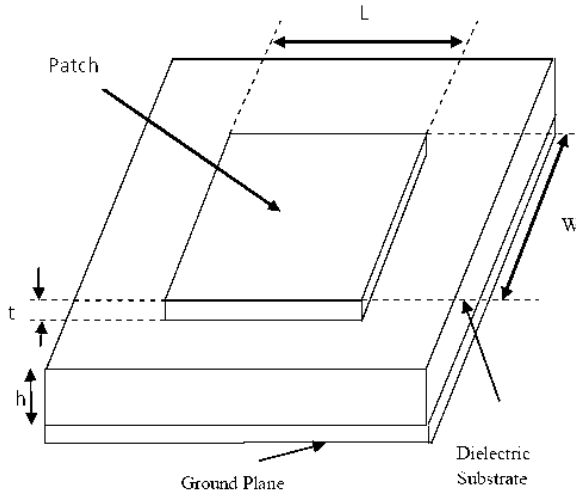


Figure-3: Structure of rectangular Micro strip patch antenna

### III. COMPARISSION BETWEEN MICROSTRIP ANTENNAS

Characteristics	Micro-strip patch antenna	Micro-strip slot antenna	Printed dipole antenna
Profile	Thin	Thin	Thin
Fabrication	Very easy	Easy	Easy
Polarization	Both linear and circular	Both linear and circular	Linear
Dual frequency operation	Possible	Possible	Possible
Shape flexibility	Any shape	Mostly rectangular and circular shape	Rectangle and triangular
Spurious radiations	Exists	Exists	Exists
Bandwidth	2-50%	5-30%	30%

Figure 4: The characteristics of micro-strip patch antennas, micro-strip slot antennas and printed dipole antennas are compared.

### IV. FEEDING TECHNIQUES

There are different methods for feeding microstrip patch antennas. These can be contacting and non-contacting methods. In the contacting method, RF power fed directly to the radiating patch using connecting element ( microstrip line).

In the non-contacting method, power is transferred between the microstrip line and the radiating patch through electromagnetic coupling. There are four feeding techniques: microstrip line and coaxial probe (both contacting schemes), aperture coupling and proximity coupling (both non-contacting schemes)[5].

#### 1 Microstrip Line Feed:

A conducting strip is connected directly to edge of the microstrip patch is small in size. The advantage of this feed is that it can be etched on same substrate to provide a planar structure.

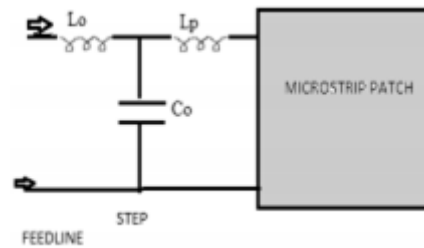


Figure 5: circuit diagram of Micro strip feed

#### 2 Coaxial Feed:

The inner conductor of the coaxial connector extends and soldered to the radiating patch and the outer conductor is coupled to the ground plane. The advantage of this is that it can be placed at any of the 26 locations inside the patch in order to match with its input impedance and there is a disadvantage also that it provides narrow bandwidth and is complex to design.

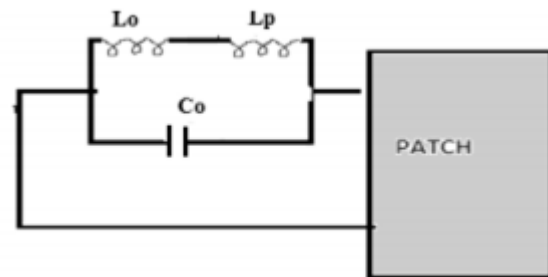


Figure 6: circuit diagram of co-axial feed

#### 3 Aperture Coupled Feed:

The radiating patch and microstrip feed line are separated by the ground and coupled through a slot in the ground plane.

The slot is centered below the patch, leading low cross polarization and radiation is minimized. The disadvantage is that it is difficult to fabricate due to multiple layers, which increases the antenna thickness.

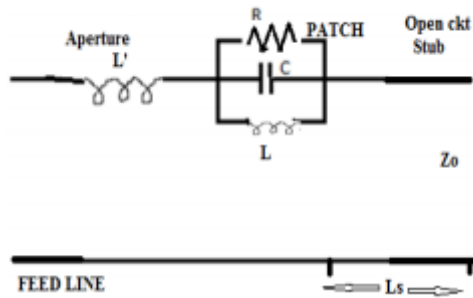


Figure 7: circuit diagram of Aperture feed

#### 4 Proximity Coupled Feed:

It is also called electromagnetic coupling scheme. Two dielectric substrates are used and the feed line is between the two substrates. The radiating patch on top of upper substrate. The advantage is that it eliminates feed radiation and provides high bandwidth. The disadvantage is that it is difficult to fabricate because of the two dielectric layers which need proper alignment[6].

## V. APPLICATIONS

The micro strip patch antennas are famous for their performance and robust design. Micro strip patch antennas engaged for civilian and military applications such as radio-frequency identification (RFID), broadcast radio, mobile systems, global positioning system (GPS), television, multiple-input multiple-output (MIMO) systems, vehicle collision avoidance system, satellite communications, surveillance systems, direction finding, radar systems, remote sensing, missile guidance. They has several other applications are discussed below[3]:

#### 1. Mobile and satellite communication application:

Mobile communication requires small, low-cost, low profile antennas. Micro strip patch antenna meets all requirements.

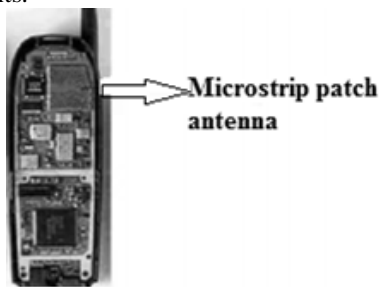


Figure8: Micro strip patch antenna use in mobile communication

In satellite communication, polarized radiation patterns are required and realized using square or circular patch.

#### 2. Radar Application:

Radar can be used for detecting moving targets. It operates on low profile, light weight antenna, the micro strip antennas are an ideal choice for this.

#### 3. Global positioning system applications:

Micro strip patch antennas have high substrate material for global positioning system (GPS). These antennas are circularly polarized.

#### 4. Radio frequency identification (RFID):

RFID is used in different areas like mobile Communication, logistics, manufacturing, transportation and health care. This system uses frequencies between 30 Hz and 5.8 GHz.

RFID system is a transponder and a transceiver.



Microstrip Antenna used in RFID

Figure 9: micro strip antenna used in RFID

**5. Medicinal applications of patch:** In the treatment of tumors the microwave energy is most effective way of inducing hyperthermia. The design of the radiator used for this purpose is light weight, easy handling and rugged. The initial designs for the Micro strip radiator based on the printed dipoles and annular rings which were designed on S-band and on the circular micro strip disk at L-band. If two coupled Micro strip lines are separated with a flexible separation which is used to measure the temperature of human body.

## VI. SIMULATION SOFTWARES FOR MICRO STRIP ANTENNA[5]

**IE3D:** IE3D is an Electro Magnetic simulation and optimization software useful for circuit and antenna design. IE3D has a menu driven graphic interface with automatic meshing, and uses a field solver based on a full-wave, method-of-moments to solve current distribution on 3D and multi layer structures of general shape.

**CST microwave studio:** CST microwave studio (CST MWS) is a tool for the 3D EM simulation of high frequency components. CST MWS enables the fast and accurate analysis of high frequency (HF) devices such as antennas, filters, couplers, planar and multi-layer structures and SI and EMC effects..

**HFSS software:** HFSS is the industry-standard simulation tool for 3D full-wave electromagnetic field simulation. HFSS provides E- and H-fields, currents, S-parameters and near and far radiated field results.

This tool is its automated solution process where users are required to specify geometry, material properties and the desired output and it automatically generate an appropriate, efficient and accurate mesh for solving the problem.

## VII. ADVANTAGE AND DISADVANTAGE

Micro strip patch antenna has several advantages like they are lighter in weight, low volume, low cost, low profile, smaller in dimension and ease of fabrication and conformity. The various advantage and disadvantage are given:

S. No.	Advantages	Disadvantage
1.	Low weight	Low efficiency
2.	Low profile	Low gain
3.	Thin profile	Large ohmic losses
4.	Required no cavity backing	Low power handling capacity
5.	Linear and circular polarization.	Excitation of surface waves
6.	Capable of dual and triple frequency operation	Polarization purity is difficult to achieve.
7.	Feed lines and matching network can be fabricated.	Complex feed structure require high performance arrays

- Ramesh Garg, Prakash Bartia, Inder Bahl, Apisak Ittipiboon, 'Microstrip Antenna Design Handbook', 2001, pp 1-68, 253-316 Artech House Inc. Norwood MA
- James j., and P.S. Hall (Eds), Handbook of microstrip antenna, Peter Peregrinus, London, UK, 1989.
- Amit kumar Jaspreet kaur Rajinder singh,(2013), Performance analysis of different feeding technique, vol 3 issue 3.
- Hemant Kumar Varshney, Mukesh Kumar, A.K. Jaiswal, Rohini Saxena and Anil Kumar (2014) Design Characterization of Rectangular Microstrip Patch Antenna for Wi-Fi Application, Vol.4, No.2, E-ISSN 2277 – 4106, P-ISSN 2347 – 5161.
- R. E. Munson "Single slot cavity antennas assembly", 3713 162, 1973
- R. E. Munson "Conformal microstrip antennas and microstrip phased arrays", IEEE Trans. Antennas Propagat., vol. AP-22, no. 1, pp.74 -77 1974
- Reference Data for Radio Engineers, pp.25 -27 1968 :Howard W. Sams
- W. F. Richards , Y. T. Lo , P. Simon and D. D. Harrison "Theory and applications for microstrip antennas", Proc. Workshop Printed Circuit Antenna Tech., pp.8/1 -23 1979

## VIII. CONCLUSION

This paper is survey on the Rectangular micro strip patch antenna .The technology used and research work increases the use of Micro strip antenna and their performance day by day and also make better utilization in future. Many techniques improve gain and bandwidth of the Micro strip Antenna. Due to this survey effect of disadvantages can be minimized. Array configuration can overcome the Low gain and power handling capacity. The feeding techniques also improve their performances. There are many simulation software are developed for micro strip antenna which make easy of designing in proper ,accurately and in automatic way with eliminating all complexity.

## REFERENCES

- R. M. Barrett, "Microwave Printed Circuits The Early Years", IEEE Trans. Microwave Theory Tech., vol32, no. 9, pp. 983-900, September 1984.
- H. Howe, "Microwave Integrated Circuits –An Historical Perspective:, IEEE Trans. Microwave Theory Tech., vol. 32, no. 9, pp. 991-996, September 1984.