WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

A Review on Compact Microstrip Patch Antenna Design for Wireless Applications

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ABSTRACT-

A study of compact antennas for fifth generation wireless communication, operating in the K and Ka bandfrequencies is discussed in this paper. Antennaminiaturization is achieved by making a simple rectangular slot in the patch. The overall size of the antenna is 6.3 mm×6.0 mm. The proposed patch size is 4.6mm×3.6 mm, which means that an invisible measure of miniaturization has been achieved. The discussed antennas are designed on a RogersRT5880 substrate considering a thickness of 0.787mm. A maximum gain of 7.43 dB at 24.1GHz is achieved by the antenna. The rapid development of wireless communication in recent years leads to the development of many wireless portable devices such as wireless sensors, smart phones, IOT devices, wearables, GPS receivers. Multimedia handheld devices, high quality HD videos, high-end gaming devices and various software applications, virtual reality, augmented reality etc. are widely used. This will lead to a dramatic increase in user data traffic in the coming years. 5G is a solution to address issues such as spectrum shortages and low data rates and provides higher coverage compared to previous generation systems.

KEYWORDS: Compact, Dual Band, Miniaturization Ratio, Patch. Antenna, 5G applications

1. INTRODUCTION

In telecommunications, a microstrip antenna (also known as a printed antenna) usually refers to an antenna built using microstrip techniques on a printed circuit board (PCB). They are mostly used at microwave frequencies. Each microstrip antenna consists of a patch of metal foil of various shapes (patch antenna) on the surface of the PCB, with a metal ground plane on the other side of the board. Most microstrip antennas consist of multiple patches in a two-dimensional array. The antenna is usually connected to the transmitter or receiver via foil microstriptransmission lines. A radio frequency is used (or in the case of antennas to generate a received signal) between the antenna and the ground plane. Microstrip antennas have become increasingly popular in recent decades due to their small planar profile that can be installed in consumer products, aircraft and missiles; their simplification using printed circuit techniques; the convenience of integrating the antenna on the same board as the rest of the circuit, and the possibility of adding functional devices such as microwave integrated circuits to the antenna itself to create functional antennas.

The most common type of microstrip antenna is the patch antenna. Antennas using patches as basic array elements are also possible. A patch antenna is a narrow band, wide antenna that is built by attaching a pattern of antenna material to a metal trace bonded to a protective dielectric substrate, such as a printed circuit board, with a continuous metal layer bonded to the other side of the forming substrate. ground plane. Common microstrip antenna shapes are square, rectangular, circular and elliptical, but any continuous shape is possible. Some patch antennas do not use a dielectric substrate and are instead made of a metal patch placed above the ground plane using dielectric gaps; the resulting structure is less rugged but has a wider bandwidth. Because such antennas have a very low profile, are mechanically rugged and can be shaped to fit the curved skin of a vehicle, they are often mounted on the exterior of aircraft and spacecraft, or embedded in cellular communications equipment.

The most commonly used microstrip antenna is a rectangular patch that looks like a cut microstrip transmission line. It is about half a wavelength. When air is used as the dielectric substrate, the length of the rectangular microstrip antenna is approximately one half of the free space wavelength. Since the antenna is loaded with a dielectric like its substrate, the length of the antenna decreases as the dielectric constant of the substrate increases. The resonant length of the antenna is slightly shorter due to the extended voltage

"throw fields" that increase the length of the beam. The first microstrip antenna model is a section of microstrip transmission line with equal loads on both sides to represent radiation loss.

2. LETERTUE REVIEW

Swaraj Panusa (2018)- In this paper, the design, optimization and simulation of a dual-band coaxial-fed H-slot microstrip microstrip antenna for WiMAX/WLAN application is presented. It operates in the 3.6-3.7GHz and 5.7-5.8 GHz bands. The radiating patch lies on a Teflonsubstrate with dielectric constant. The coaxial feeding technique is used to feed the antenna with an impedance of 50 ohm. This proposed antenna improves the return loss of -14 dB at 3.65 GHz and -28 dB at 5.765 GHz frequency. It shows a maximum gain of 8 dB at 3.65 GHz and 9dB at 5.765 GHz.

Sunil kumar (2018)- In this paper, the bandwidth of the rectangular Microstrip antenna is enhanced with an 'H' shaped rectangularmicrostrip patch. For some applications where increased bandwidth is required, dual patch antennas are one solution.

The proposed antenna has a dual frequency band. In the first frequency band (1.63-1.79GHz) the fractional bandwidth is 9.35% and in the second frequency band (2.4-3.34 GHz) the fractional bandwidth is 33.03%. Gain improved to 3.82dBi, directivity 3.87dBi and efficiency 98.91%. The proposed ‘H’shaped Microstrip antenna is provided with a 50Ω Microstrip feed line. The antenna design and performance of the 'H' shapedmicro-strip antenna is inspired by IE3D zeland software. Today in radar and satellite communication systems, microstrip patch antennas are very popular because of their low profile, mechanical strength, compactness and lightness and they can be dual-functional. Unfortunately, they have some limitations, especially low bandwidth.

Mithilesh Kumar (2019)- Antennas are important components in communication systems and play a role in transmitting and receiving signals. In modern wireless communication systems, the multiband antenna has been playing a very important role in wireless service requirements. Now a days, antennas with multiband capability have become very necessary in satellite and mobile communication systems to meet the increasing system complexity. With the rapid development of modern wireless communication systems, antenna design has become increasingly focused on wide multiband and small, simple structures that can be easily manufactured. Compact, multiband, low-cost and low-cost antennas are widely used in personal communication devices and the rapid development of wireless communication systems.

Omar Noori (2020)- Multiple antennas are very important for many application like cell phone jammer. A new shapetriple-band microstrip antenna is proposed in this paper. With h-shaped patch gaps placed in the center of the microstrippatch, a three-band character can be achieved. Procedures for selecting the length and location of h-shaped spaces were discussed in detail. The required antenna gain, input impedance, radiation pattern and return loss were achieved. The rapid development in communication systems, has motivated researchers to create low profile, small size, lightweight, and single feed rods. Such antennas are highly desired for applications that require multi-frequencies into a single piece of device.

D.Pavithra (2022)- A new high gain, wideband H-shape slot loaded microstrip patch antenna is presented in this paper. The antenna is printed on a dielectric substrate, supported by a metal board, and fed directly through a 50 Ω coaxial cable. Using the ADS software package according to the specified size, the antenna is simulated. The combined effect of combining these techniques and introducing a novel mounted clip provides a low profile, wide bandwidth, high gain and compact antenna feature. Computer simulation results show that the antenna can detect wide band characters. With adjusted parameters, it shows a wide impedance bandwidth at the frequency of 2.42 GHz.

Mayank Dwivedi (2023)-In this paper a proposed design of microstrip patch antenna is used to generate dual wideband, suitable for IEEE802.11b application. By introducing parallel slots, two bands covering the range 2.25- 2.55GHz (12.5%) and 1.57-1.68GHz (6.76%) are available. The antenna is fed by a coaxial probe feeding process. The microstrip patch is fabricated on a glass epoxy substrate with a dielectric constant of 4.2 and simulated in IE3D Zeland software. It is compact and ideal for IEEE 802.11b applications. Simulation results with frequency responses and radiation patterns are presented and discussed.

3. CONSTRUCTION AND WORKING OF MICRO STRIP ANTENNAS

A Micro strip antenna consists of a very thin metal strip placed on a ground plane with a di-electric material in between. The emitting element and the feed lines are placed by the process of embedding the image in the di-electric material. Generally, a piece or strip is chosen to be square, circular or rectangular for ease of analysis and processing. The following picture shows a micro-strip or patch antenna.

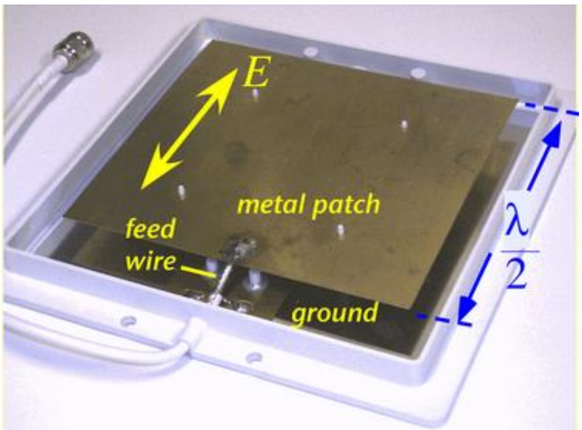

Figure. 1. Micro strip Antennas

4. RADIATION PATTERN

The radiation pattern of microstrip or patch antenna is broad. It has low radiation power and narrow frequency bandwidth.

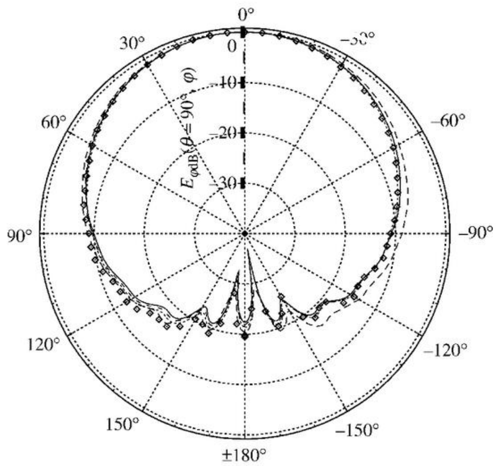

Figure. 2.Radiation Pattern

The radiation pattern of a microstrip or patch antenna is shown above. It has little direction. For greater control, a system can be built using these patch antennas.

5. MODE OF APPLICATIONS

Following are the types of antennas according to the modes of applications

- Point-to-point communications
- Broadcasting applications
- Radar communications
- Satellite communications

Basic communication principles are discussed in this chapter to have a better idea about wireless communication using sticks. Wireless communication is done in the form of waves. Therefore, we need to look at the properties of waves in communications.

- Frequency
- Wavelength
- Impedance matching

- VSWR & reflected power
- Bandwidth
- Percentage bandwidth
- Radiation intensity

6. FREQUENCY

According to the standard definition, "The rate of repetition of a wave in a certain time, is called the frequency."

Simply put, frequency refers to the process of how often an event occurs. A time wave repeats itself after 'T' (time) seconds. The frequency of periodic waves is nothing but the frequency of time (T).

7. WAVELENGTH

According to the general definition, "The distance between two consecutive high points (crests) or between two consecutive low points (troughs) is known as the wavelength."

Simply put, the distance between two adjacent peaks or two negative peaks is nothing but the wavelength of that wave. It can be called Wavelength. The following figure shows a periodic waveform. The wavelength (λ) and amplitude are shown in the figure.

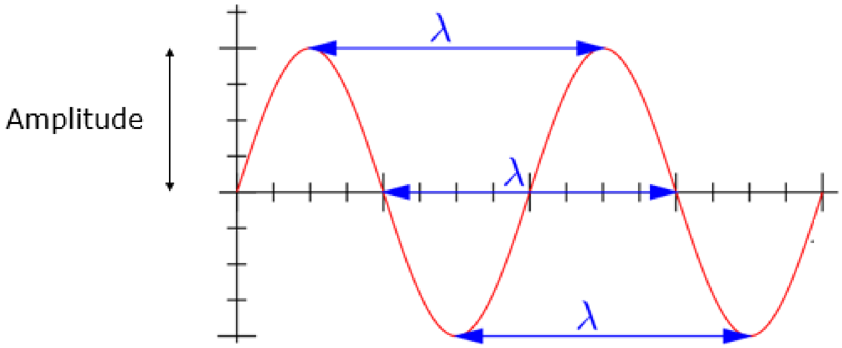

Figure. 3. Wavelength

8. IMPEDANCE MATCHING

According to the general definition, "The relative value of the impedance of the transmitter, if it is equal to the relative value of the impedance of the receiver, or vice versa, is called the similarity of the interference."

Impedance matching is required between the antenna and the circuitry. The impedance of the antenna, transmission line, and circuit must be the same for maximum power transfer to occur between the antenna and the receiver or transmitter.

9. NECESSITY OF MATCHING

A noisy device is one, which gives better output in a certain narrow band of frequencies. Antennas are such powerful devices that their impedance when matched, gives better output.

• The power emitted by the antenna, will emit radiation effectively, if the antenna is compatible with the restriction of free space.

• For the receiver, the output contact of the antenna should match the input contact of the receiver's amplifier circuit.

• For a transmitting team, the input to the antenna must match the output impedance of the transmitter amplifier, and the impedance of the transmission line.

10. CONCLUSIONS

According to the standard definition, "The ratio of high voltage to low voltage in a standing wave is known as the Voltage Standing Wave Ratio."

If the impedance of the antenna, the transmission line and the circuit are not compatible with each other, then the power will not be transmitted effectively. Instead, some energy is reflected back.

• The term, which shows the difference in impedance is VSWR.

• VSWR stands for Voltage Standing Wave Ratio. It is also called as SWR.

• The higher the impedance mismatch, the higher the VSWR value.

• The ideal VSWR value should be 1:1 for active radiation.

• Shown energy is the most wasted energy. Both reflected power and VSWR indicate the same thing.

REFERENCES

1. Ahmed Khidre, et.al. “Wide Band Dual-Beam U-Slot Microstrip Antenna IEEETransactions on Antennas and Propagation, Vol. 61, NO. 3, pp.1415-1418, March 2016.

2. D. Bhattacharya et.al. “Bandwidth Enrichment for Micro-strip Patch Antenna Using Pendant Techniques”, IJER, ISSN: 2319-6890, Volume No.2, Issue No. 4, pp. 286-289, Aug. – 2019.

3. J.-S. Hong, E.P. et.al. Eighteen-pole superconducting CQ filter for future wireless applications, IEE Proc Microwave Antennas Propag 153 (2018), 205–211.

4. Muhsin Ali et.al. “Dual Band Microstrip Patch Antenna Array for Next Generation Wireless Sensor Network Applications,” electronic and Power Engineering Department, pp.39 – 43,18-19 May 2020.

5. R.Jothi Chitra, et.al.“Design of Microstrip slot Antenna foe WiMAX Apllication,” IEEE International Conference on Communications and Signal Processing (ICCSP), ISBN: 978-1-4673- 5089-1 pp.645 – 649, 22-23March 2019.

6. Sana Arif, et.al. “Dual U-Slot Triple Band Microstrip Patch Antenna for Next Generation Wireless Networks,” Electronic and Power Engineering Department, PN-Engineering College (PNEC), pp.1–6, 9-10 Dec.2018.

7. Sukhbir Kumar et.al. “Design and Study of Compact and Wideband Microstrip U-Slot Patch Antenna for WI-Max Application”, IOSR-JECE, ISSN: 2278-2834, Vol. 5, Issue 2, pp. 45-48, (Mar. – Apr. - 2021).

8. Sze, J. Y. et.al. “Bandwidth enhancement of a microstrip-line-fedprin tedwid e-slot antenna,” IEEE Transactions on Antennas and Propagation, Vol. 49, No. 7, 1020–1024, Jul. 2018.

9. T.Jayanthy, et.al. “Design and Simulation of Microstrip M- Patch Antenna with Double Layer”, IEEE Trans., AP- 978-1-4244-2690-4444, 2023.

10. Vandana Vikas Thakare et.al.“Neural network based CAD model for the design of rectangular patch antennas” JETR Vol.1 (7), pp. 129-132, October 2022.