

Lecture-1

MICROSTRIP ANTENNAS

5.1 Introduction:

Microstrip Antenna (MSA) in its simplest configuration (fig.5.1) consists of a radiating patch on one side of a dielectric substrate ($\epsilon_r \leq 10$), and has a ground plane on the other side. The patch conductors is normally of copper or gold. The dielectric constant of the substrate should be low ($\epsilon_r \approx 2.5$), so as to enhance the fringe fields which account for the radiation.

With respect to radiation properties these antennas are versatile in terms of resonant frequencies, polarization, pattern and impedance. They allow the use of additional tuning elements like pins or varactor diodes between the patch and the ground plane. The choice of the substrate is very much limited by the microwave circuit coupled to the antenna, which has to be built on the same board. The microwave circuit together with the antenna is usually manufactured by photo-etching technology.

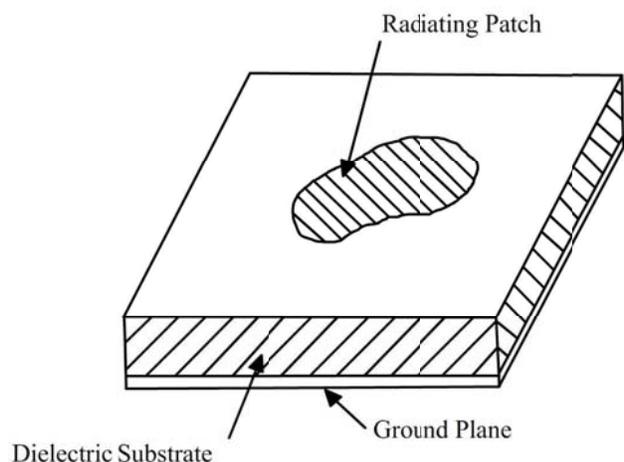


Fig.5.1 Microstrip antenna Configuration

5.1.1 Advantages of microstrip antenna:

Microstrip antenna has several advantages compared to conventional microwave antennas. These antennas are used in many applications over the broad frequency range from 100MHz to 50GHz.

Some of the principal advantages of these antennas are:

- Low weight, low cost, low profile and conformal
- Easy to fabricate and can be integrated with other microstrip components in monolithic application like RFIC and MMIC.
- The antenna can be easily mounted on missiles, rockets and satellite without major alterations.
- The antenna has low scattering cross section.
- Dual frequency antenna can be easily made.

- Microstrip antennas are compatible with modular designs (Solid state devices such as oscillators, amplifiers, variable attenuators, mixer, phase shifters etc. can be added directly to the antenna substrate board)

5.1.2 Disadvantages:

- Narrow bandwidth
- Radiation efficiency deteriorates as frequency and antenna array size increases due to an increase in the feeding network losses.
- Lower power handling capacity
- Poor isolation between the feed and the radiating elements

In recent years, with the advancement of technology, efforts have been made to minimize these effects dramatically.

5.1.3 Applications of MSA

For many practical designs, the advantages of MSA far outweigh their disadvantages. With continuous research and development, the microstrip antennas have been applied in many different and successful applications. Now a days it is the most popular antenna in the wireless communication market. We can find applications of MSA in many various fields of high-tech technology which includes:

- Satellite communication
- Mobile communication
- Missile telemetry
- Biomedical radiator
- Radar system
- Radio altimeter

5.2 Microstrip antenna configurations:

Microstrip antennas are characterized by their physical parameters. They may be of any geometrical shape and any dimension. However all the microstrip antennas can broadly be divided into three basic categories: (i) microstrip patch antenna, (ii) microstrip traveling-wave antennas, (iii) microstrip slot antennas.

(i) Microstrip patch antenna

Microstrip patch antenna consists of a conducting patch of any planar geometry on one side of a dielectric substrate backed by a ground plane on the other side. There are virtually an unlimited number of patch patterns for which the radiation characteristics may be calculated. Fig. 5.2 shows some common patch configuration.

(ii) Microstrip traveling-wave antenna

Microstrip traveling-wave antennas consists of chain-shaped periodic conductors or an ordinary long TEM line which also supports a TE mode, on a substrate backed by a ground plane. The open end of the TEM line is terminate in a matched resistive load. As antennas support traveling waves, their structures may be designed so that the main beam lies in any direction from broadside to endfire. Various configurations of microstrip traveling-wave antenna are shown in fig.5.3

(iii) Microstrip slot antenna

Microstrip slot antennas comprise of a slot in the ground plane fed by a microstrip line. The slot may have the shape of a rectangle (narrow or wide), a circle or an annulus as shown in fig 5.4.

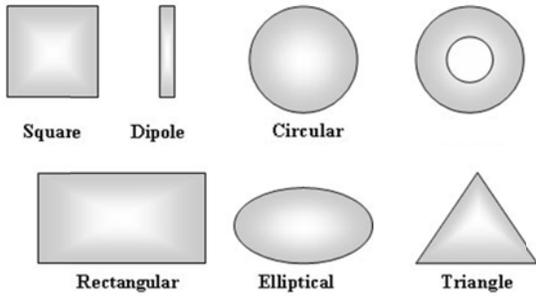


Fig.5.2 Various Microstrip patch antenna configuration

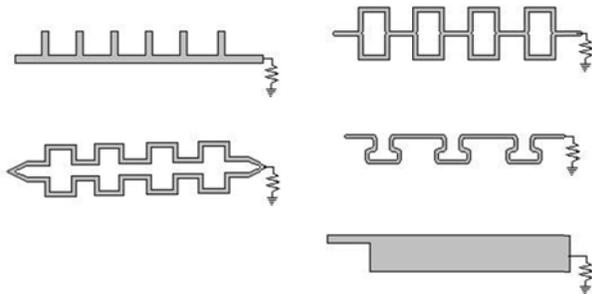


Fig.5.3 Microstrip traveling wave antenna

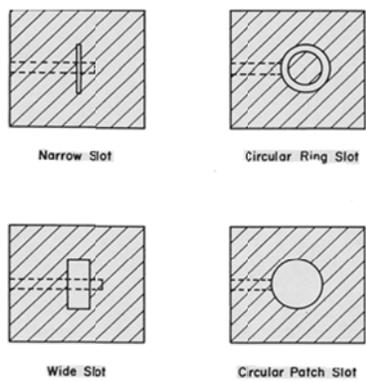


Fig.5.4 Microstrip slot antenna