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Feeding effect on bandwidth performance for design of microstrip patch antenna – A Survey

KEYWORDS

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ABSTRACT The study of Microstrip patch antennas has made great progress in recent years. Compared with conventional antennas, microstrip patch antennas have more advantages and better prospects. There are three feeding techniques for designing a Microstrip patch antenna they are Microstrip feed, coaxial feed, proximity feed. Among these coaxial feed has low return loss and better performance.

I. INTRODUCTION & MICROSTRIP PATCH ANTENNA

Antenna is a transducer designed to transmit or receive electromagnetic waves. Microstrip antennas [1] have several advantages over conventional microwave antenna and therefore are widely used in many practical applications. Microstrip antennas in its simplest configuration are shown in Fig1. It consists of a radiating patch on one side of dielectric substrate, which has a ground plane on other side.

Microstrip antennas are characterized by a larger number of physical parameters than are conventional microwave antennas. They can be designed to have many geometrical shapes and dimensions. All microstrip antennas can be divided into four basic categories:

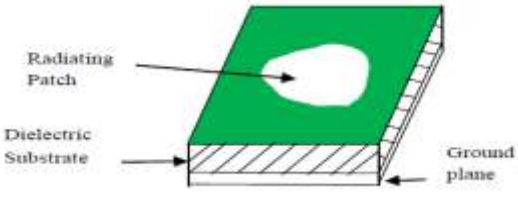

Fig 1: Microstrip antenna configuration

A Microstrip patch antenna (MPA) consists of a conducting patch of any planar or no planar geometry on one side of a dielectric substrate with a ground plane on other side. It is a popular printed resonant antenna for narrow-band microwave wireless links that require semi-hemispherical coverage. Due to its planar configuration and ease of integration with microstrip technology, the microstrip patch antenna[3] has been heavily studied and is often used as elements for an array. A large number of microstrip patch antennas have been studied to date. An exhaustive list of the geometries along with their salient features is available.

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The rectangular and circular patches are the basic and most commonly used microstrip antennas. These patches are used for the simplest and the most demanding applications. Rectangular geometries are separable in nature and their analysis is also simple. The circular patch antenna has the advantage of their radiation pattern being symmetric. A rectangular microstrip patch antenna [2-4] in its simplest form is shown in Figure 2.

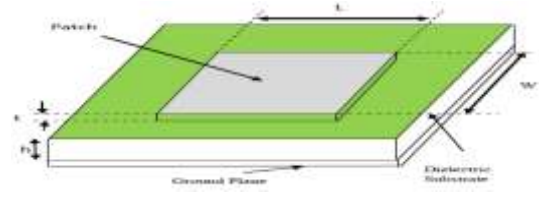

Fig 2: Structure of rectangular microstrip patch antenna

The characteristics of microstrip patch antennas, microstrip sot antennas and printed dipole antennas are compared in table 1.

Parameter	Bakelite	FR4	RO4003	Taconic	RT Duriod
Dielectric constant	4.78	4.36	3.4	3.2	2.2
Loss tangent	0.03045	0.013	0.002	0.002	0.0004
Water absorption	0.5-1.3%	<0.25%	0.06%	<0.02%	0.02%
Tensile strength	60MPa	<310MPa	141MPa	-	450MPa
Volume Resistivity	3×10^{15} Mohm cm	8×10^{7} Mohm cm	1700×10^{7} Mohm cm	1×10^{7} Mohm cm	2×10^{7} Mohm cm
Surface resistivity	5×10^{10} Mohm	2×10^{7} Mohm	4.2×10^{9} Mohm	1×10^{7} Mohm	3×10^{7} Mohm
Breakdown voltage	20-28 kv	55 kv	-	-	>60kv
Peel Strength	-	9N/mm	1.05N/mm	12N/mm	5.5N/mm
Density	1810kg/m^3	1850kg/m^3	1790kg/m^3	-	2200kg/m^3

Table 1: theoretical feeding techniques

II. Feeding Techniques

A feedline is used to excite to radiate by direct or indirect contact. There are many different techniques [5] of feeding and four most popular techniques are coaxial probe feed, microstrip line, aperture coupling and proximity coupling.

1) Coaxial probe feeding

Coaxial probe feeding is feeding method in which that the inner conductor of the coaxial is attached to the radiation patch of the antenna while the outer conductor is connected to the ground plane. Advantages of coaxial feeding is easy of

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fabrication, easy to match, low spurious radiation and its disadvantages is narrow bandwidth, Difficult to model specially for thick substrate.

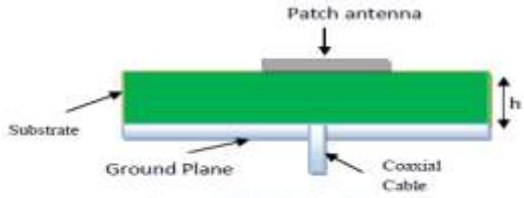

Fig 3: Coexial probe feed p

2) Microstrip line feed

Microstrip line feed is one of the easier methods to fabricate as it is a just conducting strip connecting to the patch and therefore can be consider as extension of patch. It is simple to model and easy to match by controlling the inset position. However the disadvantage of this method is that as substrate thickness increases, surface wave and spurious feed radiation increases which limit the bandwidth.

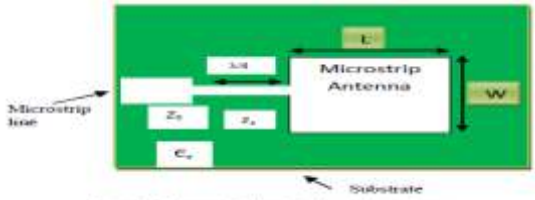

Fig 4: Microstrip line feed patch antenna

Aperture coupled feed consist of two different substrate separated by a ground plane. On the bottom side of lower substrate there is a microstrip feed line whose energy is coupled to the patch through a slot on the ground plane separating two substrates. This arrangement allows independent optimization of the feed mechanism and the radiating element. Normally top substrate uses a thick low dielectric constant substrate while for the bottom substrate; it is the high dielectric substrate. The ground plane, which is in the middle, isolates the feed from radiation element and minimizes interference of spurious radiation for pattern formation and polarization purity. Advantages is allows independent optimization of feed mechanism element.

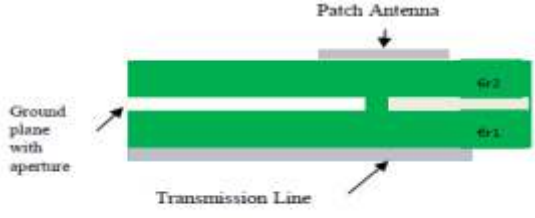

Fig 5: Aperture coupled feed patch antenna

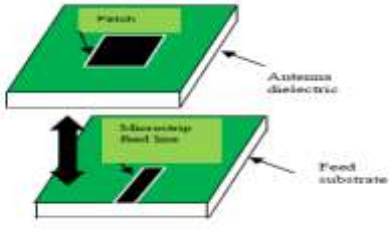

Fig 6: Proximity coupled microstrip patch antenna

The major disadvantage of this feeding technique is that it is difficult to fabricate because of the two dielectric layers that need proper alignment. Also there is increase in overall thickness of the antenna.

III. SIMULATION RESULT

1 MICROSTRIP FEED

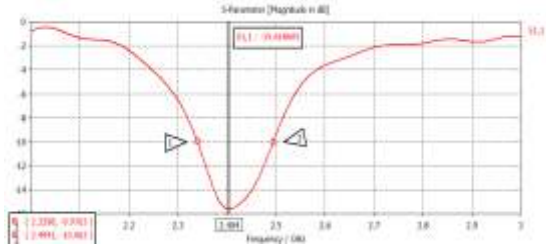

Fig 7: return loss and bandwidth plot for microstrip feed

2. COAXIAL FEED

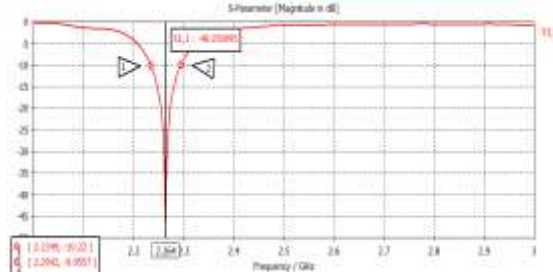

Fig 8: return loss and bandwidth plot for coaxial feed

3. PROXIMITY FEED

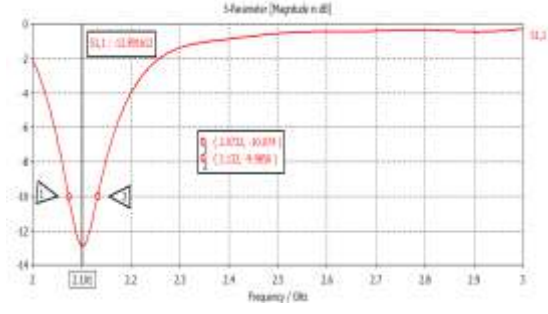

Fig 9: return loss and bandwidth plot for proximity feed

Finally the completed the three feeding techniques at the microstrip patch antenna results are,

Material name	Return loss (db)	Vswr	Bw (db)	Gain (db)	Directivity (db)
Microstrip feed (FR4)	-15.6186	1.3969	6.41	5.2	5.7
Coaxial feed(FR4)	-46.2500	1.0097	2.62	3.7	6.1
Proximity	-12.8916	1.5862	2.79	7.0	6.9

Table 2 : three feeding techniques result

CONCLUSION

A theoretical survey and performance analysis of microstrip patch antenna is presented. Microstrip antennas the three feeding techniques, among that the coaxial feed is return loss is better than another feeding techniques but the bandwidth and gain is low of the another feeding method ,but try to work at bandwidth and gain in high of the another method in the fuser work.

Volume - 5 | Issue - 1 | Jan Special Issue - 2015 | ISSN - 2249-555X

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