Transmission Line Feed Wide Band Antenna for Satellite Communication

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Abstract: *Satellite plays an important role in the interaction between different satellite subsystems and Earth during operations. Antennas are transmitted to the downlink signal and receive the uplink signal. It gives signal connection to primary satellites. The condition of the satellite antenna is to cover the required area. Today, microstrip patch antennas determine their request in satellite space communications, biomedical and so on. Insist on the small size, low cost, small shape, and flat construction of the antenna to be carried out on consumer terminals. Microstrip-integrated antennas have increased interest in mobile satellite data systems.Transmission line-fed antennas have features like easy integration for monolithic integrated circuit, low dispersion, and low radiation loss with dual layer and rectangular patch and slots are cutted from the top and bottom layer with the use of transmission line feed. In this paper, we discussed the effect of parasitic patch over the microstrip antenna. We use three transmission line feed where we analyze that for all the ports in active condition means the proposed antenna gives a wide bandwidth rather the single port active and other act as a parasitic patch. We achieve the 5.94 GHz wide satellite band and 259.630 by design of simple structure in the top and bottom layer of the patch. The work is designed by the MoM based software IE3D.*

Keywords**—** **Compact, Patch, Layer, Impedance, Band-Width.**

I. INTRODUCTION

The microstrip antenna concept was introduced for the first time in the 1950s. Microstrip antennas have many advantages such as their use in commercial and military applications. However, the conventional microstrip antennas have a bandwidth of only a few percent resistance and the radiation pattern with the omni-directional radiation scheme, which obviously does not meet the ultra-wide bandwidth requirements (UWB), high gain, miniaturization, circular polarization, [1-6], we have a wide range of microstrip antenna topologies, including structures of different microstrip antenna elements and different microstrip array arrangements [7-15].

To replace the conventional bulky antenna we have some microstrip antennas with special topologies, like quasi-Yagi, planar reflector antenna. This paper outlines the procedures for designing a microstrip antenna using the feed of the transmission line for satellite communications. Unlike other antennas, there are other antennas such as DRA (aerial resonance buffer), fractional antenna, etc. to reduce the antenna size [16-21]. Fractal antennas are difficult to design and need DRA to high dielectric substrates are not readily available.

The primary objective of this paperwork is to provide an extensive overview of design analysis and microstrip antenna improvement criteria and its application in the next generation and also to provide a cost-effective solution. In addition, it aims to provide a direct forward-looking approach to optimizing the microstrip antenna, operating within the frequency band to improve performance. Because the size of the microstrip antenna is inversely proportional to its frequency, the larger the antenna, the less it can detect. For this single reason, microstrip antennas are generally antennas capable of sensing low frequencies unlike microwave, and detect large frequencies; making it difficult to use in smaller electronic devices.

The simulation was performed by IE3D [22] using MoM method. Due to their small size, low cost and light weight, this antenna is a good candidate for the intended application.

II. ANTENNA DESIGN

The proposed antenna configurations are displayed in Figure 1 and Figure 2. Two straight equal slots (L1, L2) are cut at the bottom of the left and right side of the patch edge and one parallelogram slot inserted at the top of the patch in the upper layer shown in Fig. -1. One rectangular patch is cut on the left side of the patch edge from the bottom layer and a rectangular slot with triangular slit is also removed on the right side of the patch edge of the bottom layer, i.e. at the ground level as shown in Figure 2. The specified materials for this paper are PTFE substrate with dielectric constant (ε_r) = 4.4 and height of substrate (h) = 1.6 mm. Single transmission line feed is used in the top layer and twice transmission line feed is used in ground layer. Figure 1 displays designed antenna top layer structure and Figure 2 displays designed antenna ground layer structure.

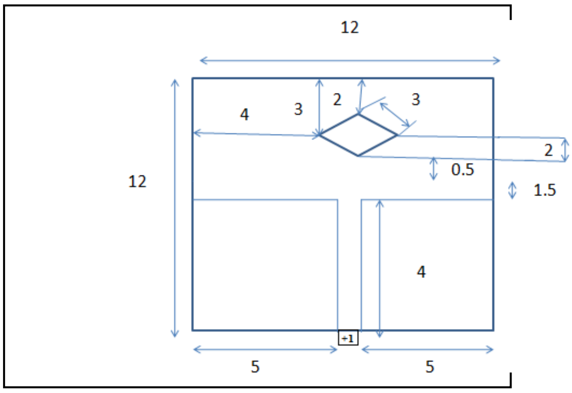

Fig 1: TOP LAYER STRUCTURE

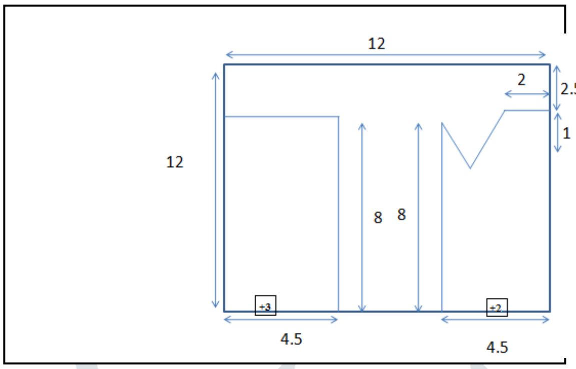

Fig 2: BOTTOM LAYER STRUCTURE

Designed antenna are a square patch which dimensions are 12mm x 12mm with the use of same insulation materials.

III. RESULTS AND DISCUSSION

Different parametric analyzes for designed antenna is analyzed and displyed. Several antenna parameters have been investigated for improved bandwidth and antenna loss and return. Figure 3 shows the proposed return loss of the proposed antenna when all ports are active Figure 4 shows the proposed simulation loss of the proposed antenna when one of the ports is active and the other acts as a parasite correction.

Since the aperture is cut in the correct position from the top and bottom layer of the antenna patch, the resonance frequency operation is obtained at large values of the frequency ratio with a significant loss of antenna return. Table 1, Table 2 and Table 3 discuss the detailed analysis of return loss, absolute gain and beam width of the proposed antenna.

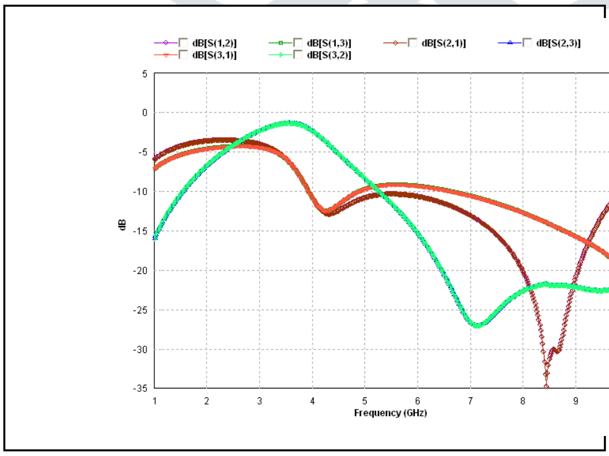

Fig 3: Return Loss Pattern at All Ports active

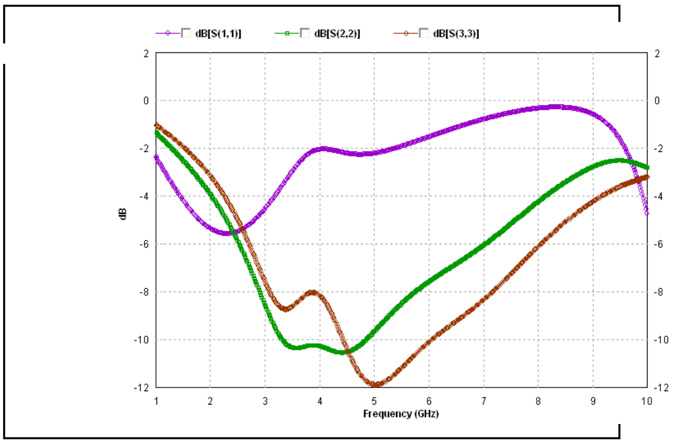

Fig 4: Return Loss pattern at one port active

III.I. Simulated Radiation Pattern

E-plane and H-plane radiation patterns for each of the resonance frequencies are illustrated in Figure 5 to Figure-10.

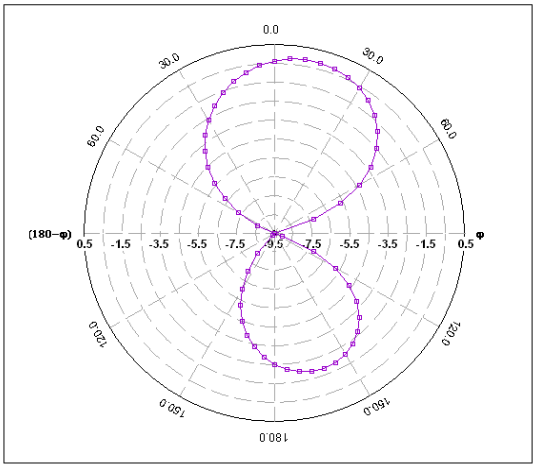

Fig 5: 8.54 GHz Electric Field Pattern

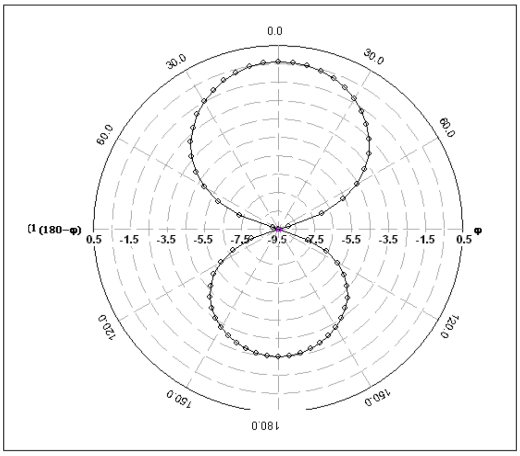

Fig 6: 8.54 GHz Magnetic Field Pattern

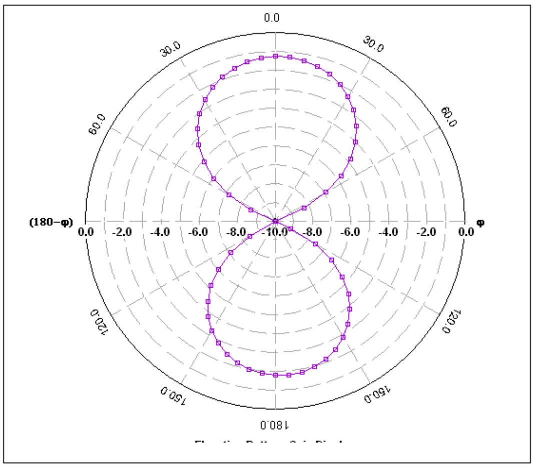

Fig 7: 4.22 GHz Electric Field Pattern

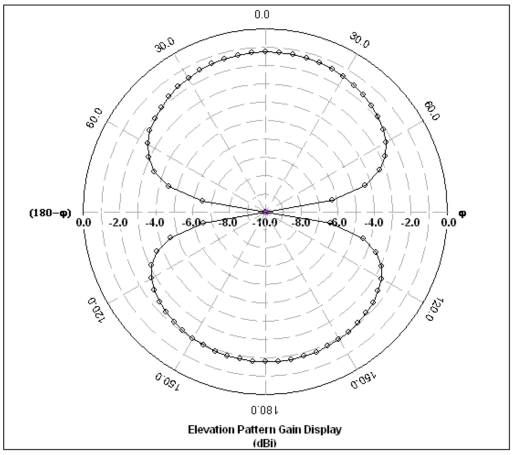

Fig 8: 4.22 GHz Magnetic Field Pattern

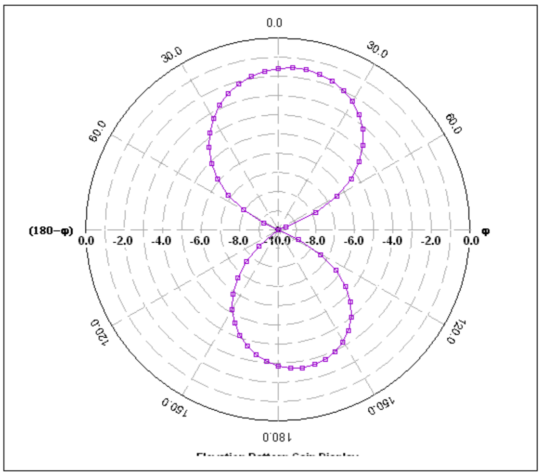

Fig 9: 7.09 GHz Electric Field Pattern

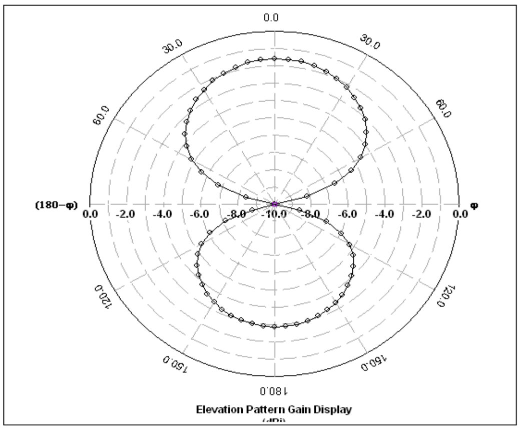

Fig 10: 7.09 GHz Magnetic Field Pattern

All cumulative result are illustrated in Table I, Table II and Table III which is discussed below:

TABLE I: *FREQUENCY WITH GAIN AT ALL PORTS ACTIVE*

EFFECT OF ONE PORT TO OTHER	RESONANT FREQ. (GHz)	FREQ. RATIO	3 DB BEAM WIDTH (^{0})	ABSOLUTE GAIN (dBi)
(1,2) & (2,1)	f_1= 8.54	-------	89.07^0	-0.18
(1,2) & (2,1)	f_1= 4.22		91.44^0	-1.28
	f_2= 9.98	f_2/f_1=2.364	115.38^0	1.64
(1,2) & (2,1)	f_1= 1.00		259.63^0	-13.62
	f_2= 7.09	f_2/f_1=7.090	92.20^0	-1.54

TABLE II: *FREQUENCY WITH RETURN LOSS AT ALL PORTS ACTIVE*

EFFECT OF PORT ON OTHER	FREQUENCY (GHz)	RETURN LOSS (dB)	BANDWIDTH (Hz)
(1,2), (2,1)	f_1=8.54	-34.50	5.940 G
(1,3), (3,1)	f_1=4.22 f_2=9..98	-12.45 -20.9	975.14 M 3.380 G
(2,3), (3,2)	f_1=1.00 f_2=7.09	-15.89 -27.03	554.00 M 4.710 G

TABLE III: *FREQUENCY WITH RETURN LOSS AT ONE PORT ACTIVE*

PORT (ACTIVE)	FREQUENCY (GHz)	RETURN LOSS	BANDWIDTH (GHz)
1	-	-	-
2	f_{c1} =3.50 f_c = 4.01 f_{c2} = 4.32	-10.25 -10.31 -10.51	1.52
3	f_1=5.00	-11.86	1.61

IV. CONCLUSION

Proposed designed antenna useful for satellite communication by using transmission line feed. The proposed antenna exhibit miniaturization, lower return loss, better impedance matching and high gain compared to the other microstrip patch antennas. The observed radiation patterns are stable within the frequency band. It is very easy to design and fabricate. Two straight equal slots (L1, L2) are cut at the bottom of the left and right side of the patch edge and one parallelogram slot inserted at the top of the patch in the upper layer shown in Fig. -1. One rectangular patch is cut on the left side of the patch edge from the bottom layer and a rectangular slot with triangular slit is also removed on the right side of the patch edge of the bottom layer, i.e. at the ground level, the big improvement shows a maximum loss of yield at -34.50 dB with a wide band of 5.94 GHz. Another finding was observed that for the proposed antenna, the maximum beam width of the 259.63^0 radiation scheme would be sufficient for the intended applications.

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