MULTIBAND CIRCULAR MICROSTRIP ANTENNA USING TRANSMISSION LINE FEED

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***Abstract**- In this project, a Microstrip Patch antenna is introduced to connect to the microwave. The microstrip patch antenna theory is used to design small slots to obtain the required broadband. The projected antenna is emulated using New Zealand's IE3D program, which uses a MoM-based system. A simulated test of this antenna was performed for a frequency range of 1 to 10 GHz. Several antenna characteristics such as return loss, radiation pattern, percentage bandwidth, directivity, antenna gain, radiation efficiency, voltage standing wave ratio, return loss, and gain etc. are studied for the proposed antenna with conventional circular microstrip patch antenna of same dimensions. The circular patch antenna is designed on a FR4 substrate with dielectric constant εr = 4.4 and height of the substrate is 1.6 mm. We are trying to design circular patch antenna of return loss value below -15dB. Since the circular microstrip patch antenna is designed for satellite communication applications such as transponder etc. The simulated parameters are good enough for the intended applications.*

Keywords – **Dual-Band, Slot, Dielectric Constant, Circular patch, Gain, VSWR**

I. INTRODUCTION

In the new communications era, the microstrip design of the small antenna creates challenges among young engineers, especially for microwave engineers [1]. For microwave transitions, we need a small, light-weight antenna, and on this basis the Microstrip Antenna is the most suitable device. For microwave communication as well as for wireless communication, more than one operating frequency is required per day for many reasons. Operating frequencies are required mainly because most microwave and wireless engineers use different communication bands and engineers use different frequency bands. Therefore, engineers recently designed antennas with multiple properties. Another standard required for antenna design is to reduce the size. Reducing size is the new method. In this way, the size of the antenna is the same as for the conventional antenna. To reduce size, the most useful technique is to cut different structures in the correct position on a traditional microstrip antenna [2-5]. Reducing the size of the antenna means a very low resonance frequency for the cleaved antenna compared to the traditional antenna [6-8]. Unlike slotted antennas, there are other antennas such as DRA (Insulated Ring Antenna), Fractal Antenna, etc. used to reduce antenna size [15-20]. Hard to design fractal antennas and DRA need to high substrate substrates are readily available. Today, microstrip micro size of the microstrip is very small and can be reduced to increase demand for applications in various communications, especially microwave and mobile communications [9-10].

Microstrip antenna widely used in the defence systems like missiles, aircraft, satellites and rockets. The large bandwidth of UWB antennas will improve the performance in the various applications of communication. A Micro Strip Antenna consists of a tiny metallic patch etched on a dielectric substrate. These antennas are mechanically rugged, compact conformable to planar and non-planar surfaces and relatively cheap to manufacture with the latest printed circuit technology. Apart from the rectangular micro strip antennas, circular micro strip antennas are also more popular due to their convenient shape. Antenna design is one of the primary challenges in the development of UWB systems especially when low cost, compact and radiation efficient structures are required for UWB and radar systems.

II ANTENNA STRUCTURE

The proposed dual layer triple transmission line feed antenna shows in following figure is designed on FR-4 substrate having relative permittivity = 4.4. To obtain impedance matching between the feeding and the radiation element, the signal strip width of the upper-side will be cut from radiating disk element. The antenna size is 12 mm * 12 mm and is separated from the ground plane by 1.6mm. Top layer of proposed antenna consist of a circular patch of radius 12 mm. We cut two unequal rectangular patch with adding one rectangular slits from the upper layer and the bottom layer consisting of rectangular patch of 12 mm x 12 mm. We also cut two unequal rectangular slots with adding of two equal rectangular slots from the bottom layer which also acts as a dielectric substrate. The resonant frequency (fr) can be calculated as:

$$f_r = [c/(2*W)]*\sqrt{(2/(1+\varepsilon_r))},$$

Where c stands for free space speed of light and ε_r is the relative permittivity of the substrate material. Figure 1 shows the top layer of the substrate and figure 2 shows the bottom layer of the substrate. All simulations are done using MoM based electromagnetic solver IE3D [21].

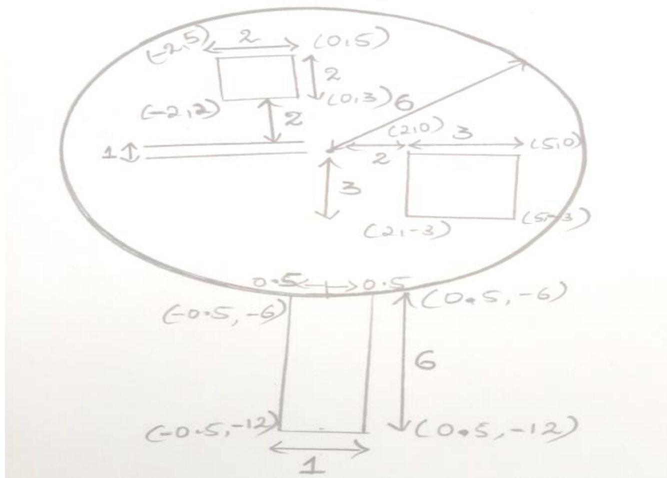

Fig 1: Proposed antenna structure (Top Layer)

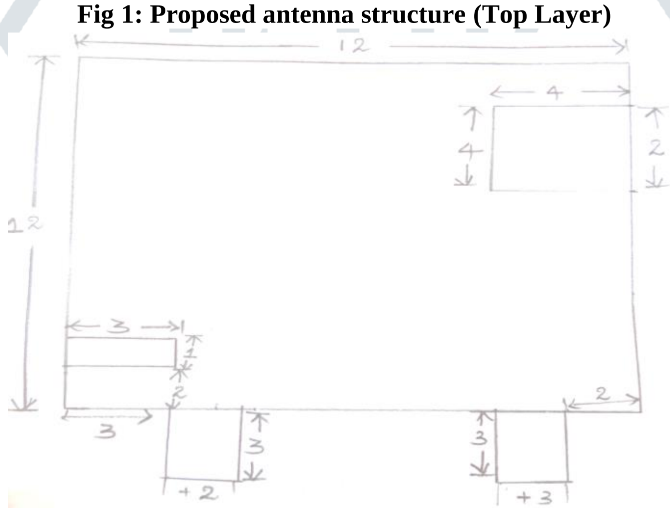

Fig 2: Proposed antenna structure (Bottom Layer)

III. Simulated Results and Analysis

Different parameter analysis of the proposed antenna is performed and displayed. Several antenna parameters have been investigated to improve bandwidth and antenna loss and loss. Figure 3 shows the proposed return loss of the proposed antenna when all transmission line ports are active. Figure 4 shows the proposed simulation loss of the proposed antenna when one of the transmission line ports is active and others act as a parasite.

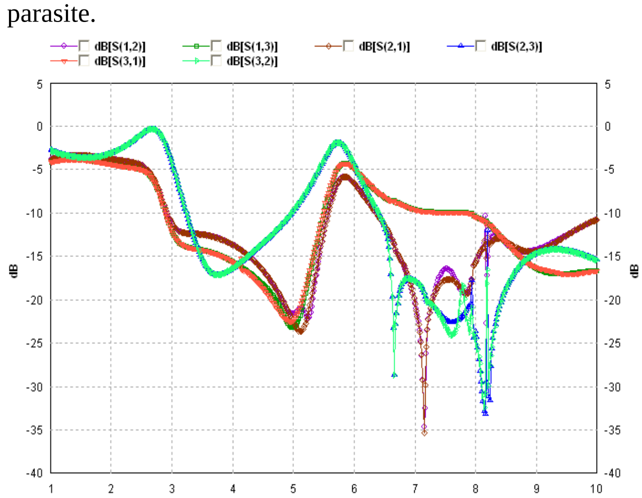

Fig 3: Return Loss Pattern at the time of all ports active

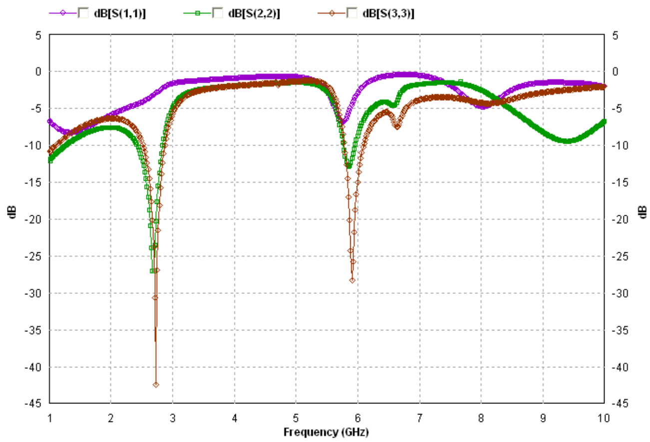

Fig 4: Return Loss Pattern at the time of one port active and other parasitic element

Since the aperture is cut in the correct position of the antenna, the resonance frequency operation is obtained at large values of the frequency ratio with a significant loss of antenna return. The first resonance frequency of the proposed antenna is obtained at f1 = 5.09 GHz with a return loss of about -23.575 dB. The second resonance frequency is obtained at f2 = 7.15 GHz with a return loss of -35.27 dB. The corresponding 10 dB bandwidth obtained for the antenna proposed in f1 and f2 is 2.65 GHz and 3.69 GHz, respectively. Figure 5 illustrates the VSWR simulation scheme against the proposed resonance frequency. The VSWR for the first resonance frequency (2.73 GHz) is 1.025. The second resonance frequency is obtained at f2 = 5.09GHz with a value of 1.08. All values are within 2: 1.

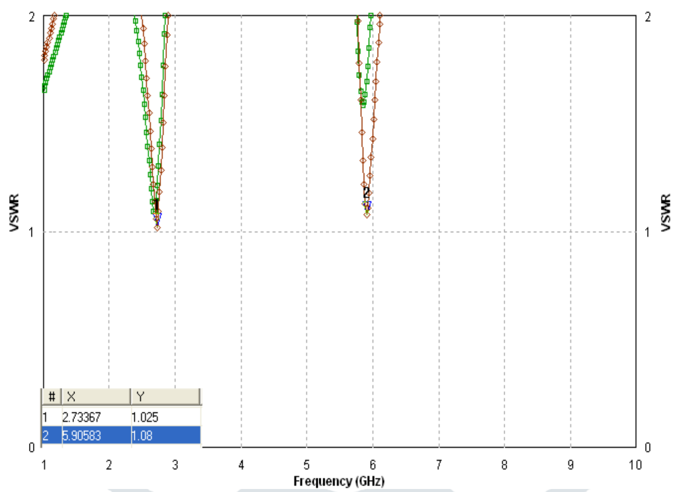

Fig 5: VSWR Pattern

III.I. Simulated Radiation Pattern

All cumulative results with the help of Table I and Table II is discussed below:

TABLE I: FREQUENCY WITH RETURN LOSS (ONE PORT ACTIVE)

ACTIVE PORT	*RESONANT FREQUENCY (GHZ)*	*RETURN LOSS (dB)*	*10dB BANDWIDTH (HZ)*
S(1,1)	-	-	-
S(2,2)	f_1=2.69 f_2=5.85	-27.03 -12.92	416.01MHZ 190.01MHZ
S(3,3)	f_1=2.73 f_2=5.19	-42.125 -27.875	359.51MHZ 313.91MHZ

TABLE II: FREQUENCY WITH RETURN LOSS (ALL PORTS ACTIVE)

ACTIVE PORT	RESONANT FREQUENCY (GHZ)	RETURN LOSS (dB)	BANDWIDTH (HZ)
S(1,2) & S(2,1)	f_1=5.09 f_2=7.15	-23.575 -35.27	2.65GHZ 3.69GHZ
S(1,3) & S(3,1)	f_1=4.88 f_2=9.65	-22.32 -16.98	2.06GHZ 2.08GHZ
S(3,2) & S(2,3)	f_1=3.72 f_2=6.66 f_3=8.16 f_4=8.23	-17.1 -28.3 -33.2 -31.4	1.74GHZ 3.6GHZ 3.6GHZ 3.6GHZ

TABLE III: FREQUENCY with GAIN

FREQUENCY	FREQUENCY RATIO	MAXIMUM GAIN (dBi)	3dB BEAM WIDTH (Deg)
f_1=2.69	-	-0.5	162.22^0
f_2=2.73	1.01	-1.13	162.82^0
f_3=3.72	1.38	-2.07	153.82^0
f_4=4.88	1.81	-4.21	147.22^0
f_5=5.09	1.89	-6.78	146.81^0
f_6=5.85	2.17	-6.28	233.31^0
f_7=5.91	2.19	-10.93	244.68^0

IV. CONCLUSION

A triple layer, three times the size of a small printed antenna, was simulated using an instantaneous program from the IE3D electromagnetic analyzer. When we cut two openings we add one rip to the microstrip antenna ring. The greatest improvement is the maximum loss loss of about -35.27 dB as well as all the values of VSWR within the range of 2: 1. Another result was also observed with respect to the proposed antenna. The three-dimensional beam width of 244.68^0 is wide enough for the intended applications.

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