

# Slot Loaded Multi-Band Gap Coupled Tunable Rectangular Microstrip Antenna

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**Abstract**— A coaxial fed frequency tunable slot loaded RMSA that resonates at multi band is presented in this paper. The rectangular patch of  $L \times W$  is placed on a FR4 substrate at a height of 72mils above a ground plane. Multi band is achieved by placing slots. Coplanar arrangement of second patch at some gap is used for frequency tuning. Designed antenna resonates at multi band (10.6GHz & 20.6GHz) which can be used for the X-Band (Radar, Satellite Communication, and Wireless Computer Networks) and K-Band (Long Distance Communication). Tuning of these frequencies is also presented. Designed patch has a good impedance matching with an average gain of 9dB.

**Key words:** Microstrip Patch Antenna, Multi Band and Frequency Tunable Antennas, Coaxial Feed

## I. INTRODUCTION

The microstrip patch antenna is widely chosen item for several performance systems that can contemporarily care devices functioning at diverse bands of frequency such as wireless local area network (Wireless LANs), universal mobile telecommunication services (UMTS), and worldwide interoperability for microwave access (WiMAX) due to its features of low profile, lightweight, comfort of integration, and fabrication.

Multiband antennas have been achieved through techniques such as a cross-loaded slots in the ground plane [3], PIFA type varactor tunable [4], slots in the patch [1], with partly magnetized substrates[5], by changing the vertex of a triangular patch [6], using corner truncated sector antennas [7], using stacked arrangements [8], with EBG structures [9] with air gap [10],with liquid crystal substrates [11] etc.,

In this paper a frequency tunable slot loaded RMSA that resonates at multi band is presented. The rectangular patch is placed on a FR4 substrate at a height of 72mils above a ground plane. Patch is loaded with multiple slots to achieve multi band. With a second patch at a gap 's' from the first patch, frequency tuning is achieved. Designed antenna resonates at X-Band and K-Band. Tuning of these frequencies is shown by varying the gap between the two patches.

The multi bands of frequency of the design are shown to be tuned to different frequencies by varying the gap from 9.0 to 9.6mm. 2.

Designed Gap coupled slot loaded RMSA resonates at triple frequencies (10.5GHz, 13.0 & 20.4GHz) with a gap of 9.7mm. This RMSA can be used for the applications of X-Band(radar, satellite communication, and wireless computer networks), Ku-Band(direct broadcast satellite services) and K-Band( long distance). All the designs produces an average gain of 9dB which can be used for long distance applications. The basic design [1] is shown in fig1.1.

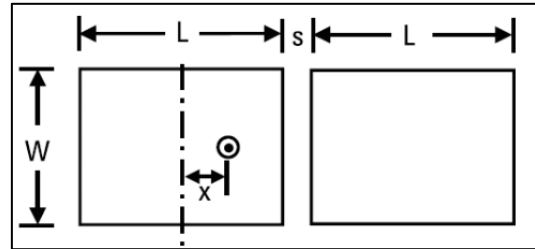


Fig.1.1 Frequency tunable Microstrip Antenna with gap

## II. ANTENNA STRUCTURE

Designed coaxial feed rectangular microstrip antenna of  $1.19 \times 0.9$  cm on FR4 substrate with dielectric strength 4.4 over a ground plane of  $L_g \times W_g$  is shown in fig2.1.

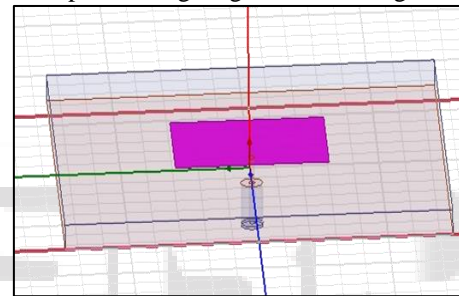


Fig. 2.1: (a) Front View of the designed single patch

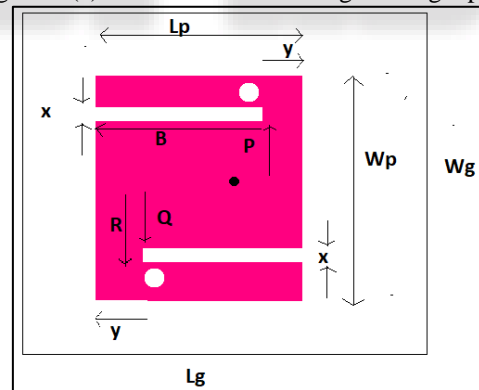


Fig. 2.1: (b) Details of the Patch

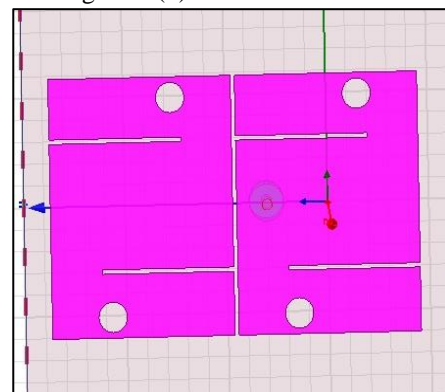


Fig. 2.1: (c) Top View of designed patch

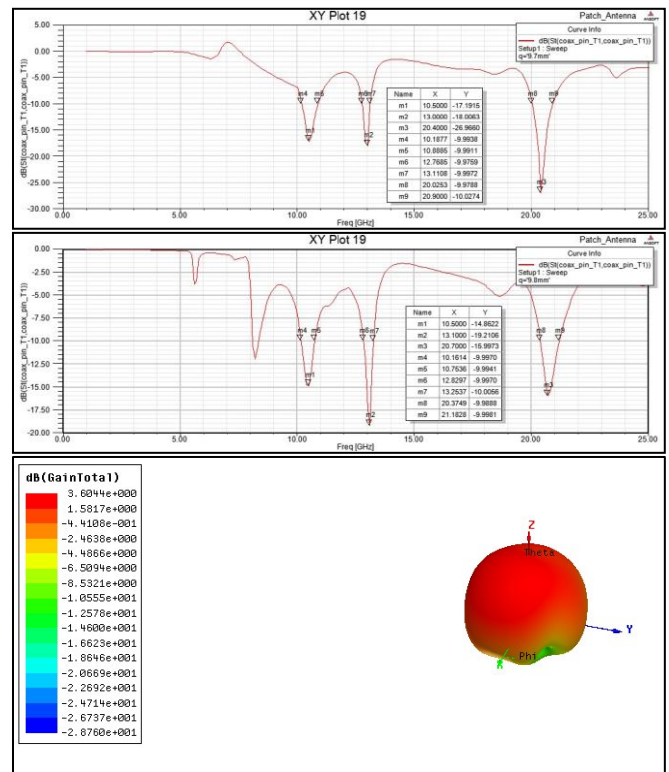
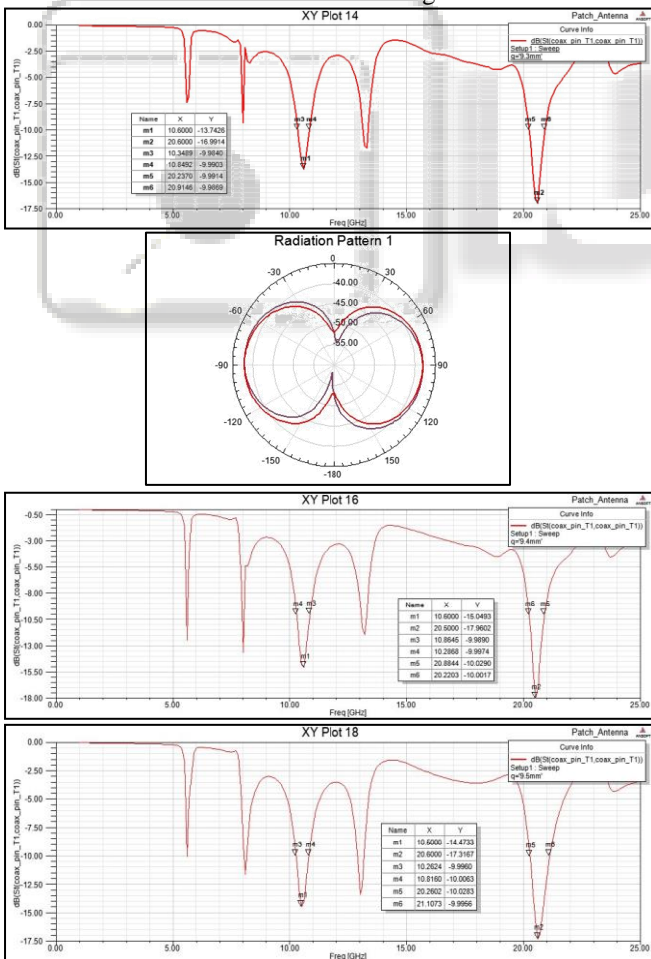
Name	Value
Wg(width of ground plane)	3cm
Lg(Length of ground plane)	3cm
h2(height of RT Duroid)	4.4
Wp(width of patch)	1.19cm
Lp(length of patch)	0.9cm
Fd(feed position)	(0,0.3)
X(Rectangular slot)	0.02cm
Y(Rectangular slot)	0.225cm
P	0.3cm
Q	0.4cm
B	0.65cm
D(Diameter of circular slots)	0.14cm
S(Gap between patches)	Variable

Table 1.1 Details of the designed patch

### III. SIMULATED RESULTS

Gap (mm)	Frequency			Return loss			Gain			Bandwidth		
	f1	f2	f3	S11@f1	S11@f2	S11@f3	G@f1	G@f2	G@f3	BW@f1	BW@f2	BW@f3
9.2	10.7	20.6	--	-13.92	-13.56	--	7.89	7.28	--	0.4594	0.1207	-
9.6	13.1	20.8	--	-15.69	-15.44	--	8.15	6.970	--	0.3276	0.7722	-
9.7	10.5	13.0	20.4	-17.19	-18.006	-26.966	7.42	7.97	8.13	0.7	0.34	0.87
9.9	12.9	20.5	--	-20.07	-17.8	--	7.55	7.89	--	0.3824	0.83	-
1	12.9	20.6	--	-23.34	-16.7	--	7.32	7.46	--	0.404	0.8765	-

Table 3.1 Results of the Designed Patch



### IV. CONCLUSION

Designed Gap coupled slot loaded RMSA using Ansoft HFSS V13.0. Designed antenna resonates at dual frequencies (10.6GHz & 20.6GHz) with a gap of 9.2mm. This RMSA can be used for the applications of X-Band (Radar, Satellite Communication, and Wireless Computer Networks) and K-Band (long distance). The resonant frequencies of the design can be tuned to 13.1GHz & 20.8GHz by varying the gap to 9.6mm. The resonant frequencies of the design can be tuned to 12.9GHz & 20.5GHz by varying the gap to 9.9mm. Designed Gap coupled slot loaded RMSA resonates at triple frequencies (10.5GHz, 13.0 & 20.4GHz) with a gap of 9.7mm. This RMSA can be used for the applications of X-Band (radar, satellite communication, and wireless computer networks), Ku-Band (direct broadcast satellite services) and K-Band (long distance). A method to tune the frequency of microstrip patch is presented. The proposed method has been from early work i.e., tuning of patch using air-gap. The presented paper is based on E-shaped microstrip patch antenna on a Rogers RT/duroid 5880 dielectric substrate with permittivity of 2.2 at located a height h2 suspended over a ground plane. By placing an adjustable air-gap of height h1 between the substrate and ground plane, patch can be tuned at dual frequencies. Dual frequencies are obtained by tuning the air-gap for 8mm, 9mm, 10mm, 11mm, 11.5mm values for a fixed duroid substrate height(s). Hence the designed patch can be recommended for wireless applications.

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