Design of Multiband Antenna for GPS and IRNSS Receivers

[1]Zalak Patel
[1]Assistant Professor
[1]Electronics & Communication Engineering Department,
[1]Indus University, Ahmedabad, India

Abstract: This antenna is designed to operate in 2 frequencies that range from 1.610-1.625 GHz and 2.483-2.5 GHz. The design is obtained by using a single Microstrip patch antenna with a single feed by inserting two pair of slits placed near the edges of the patch. An air gap has been inserted to improve the gain. The proposed design provides dual band operation in L and S band as well Circular Polarization needed for the hand held receivers of IRNSS & GPS systems. The work is done using Ansoft HFSS software and the designed antenna can be used in other wireless applications to have multi-band operation and to have compact structure.

Index Terms **– Global Positioning System GPS, Indian Regional Navigation Satellite System IRNSS, Microstrip Antenna MSA, Circular Polarization CP, Return Loss RL.**

I. INTRODUCTION

In telecommunications, a multi-band device (including dual-band, triband, quad-band and penta-band devices) is a communication device (especially a mobile phone) that supports multiple radio frequency bands. All devices which have more than one channel use multiple frequencies; a band however is a group of frequencies containing many channels. Multiple bands in mobile devices support roaming between different regions where different standards are used for mobile telephone services.

The tremendous advancement in wireless communication technologies together with the growing on consumer are leading the creation of mobile handsets which are smaller, lighter and more multifunctional. In order to satisfy the various demands for wireless services, multiband antenna is a good candidate.

II. OBJECTIVE

A GPS ceramic patch antenna is preferred over the other antenna types because it can be made into small format compact applications while maintaining its advantages of high gain towards the zenith, a key requirement for satellite based navigation systems. Also it is lightweight, inexpensive, and electronics like LNA's and SSPA's can be integrated with these antennas quite easily. The other key advantage is it can be made to be circularly polarized, and this matches more efficiently with the circularly polarized radiation transmitted from the GPS satellites.

The actual desired antenna is a multiband antenna for GPS and IRNSS applications using frequency bands L band (1.610-1.625 GHz)(GPS) & S band (2483.5-2500 MHz)(IRNSS).The desired dual-band operation has been obtained by proper loading for a rectangular patch antenna using slots and shorting pins.

III. DESIGN OF S BAND MICROSTRIP PATCH ANTENNA (DESIGN 1) FOR CIRCULAR POLARIZATION

To reach the aim of CP operation, a corner - truncated technology is adopted. The radiation patch is truncated by a square at two diagonal corners. A single Microstrip Patch Antenna (MPA) has been designed and simulated which covers S band (2.28 GHz), with Rogers/RT Duroid 6002 chosen as dielectric material.

Table 1: Physical dimensions of the MPA (Design 1)

Parameters	values
Frequency	2.28 GHz
Dielectric Constant	2.94
Dimension of the substrate	65x65 mm^2
Dimension of the patch	37.26mm
Loss tangent	0.0012
Thickness of the substrate	1.542 mm
Feed position	8 mm(on x-axis)(LHCP)

Figure 1: Design 1 of MPA with corner truncated for CP operation in S band

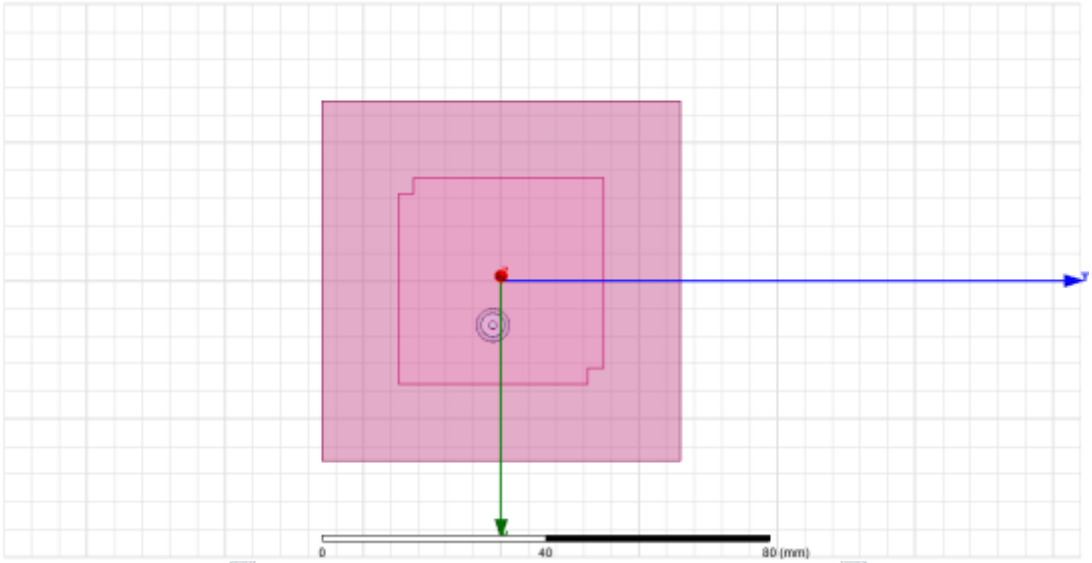

Figure 2: Design of feed for MPA proposed as design 1

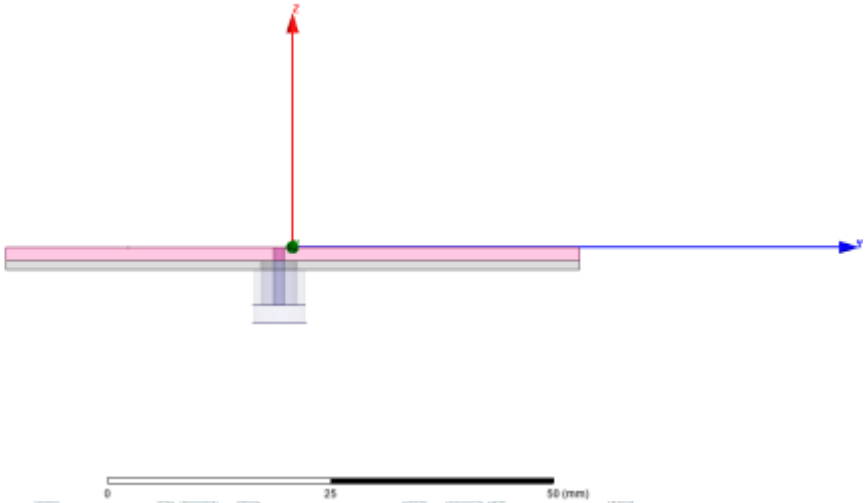

Figure 3: Simulated graph of return loss of MPA proposed as design 1

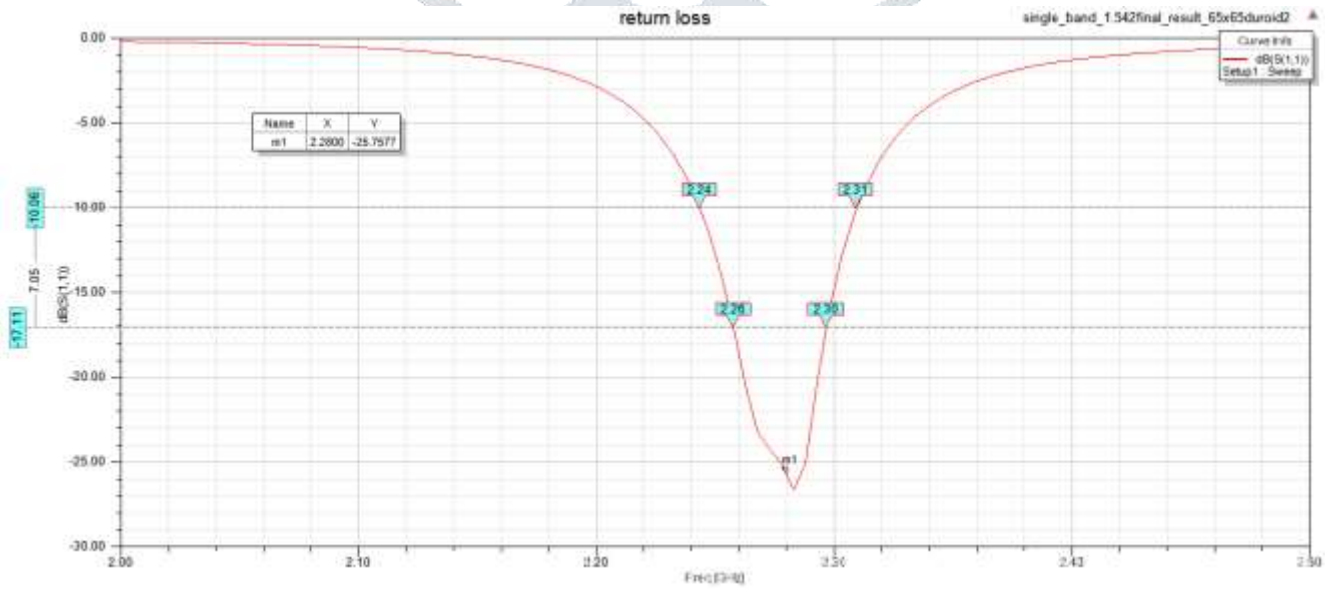

Figure 4: Simulated graph of Axial Ratio of MPA proposed as design 1

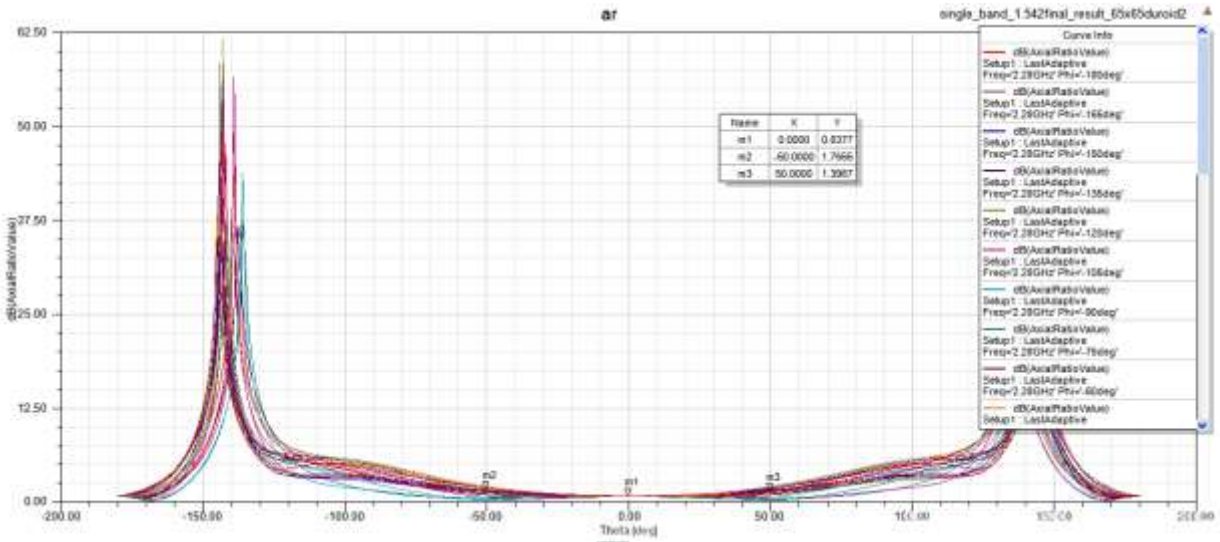

Figure 5: Simulated graph of gain of MPA proposed as design 1

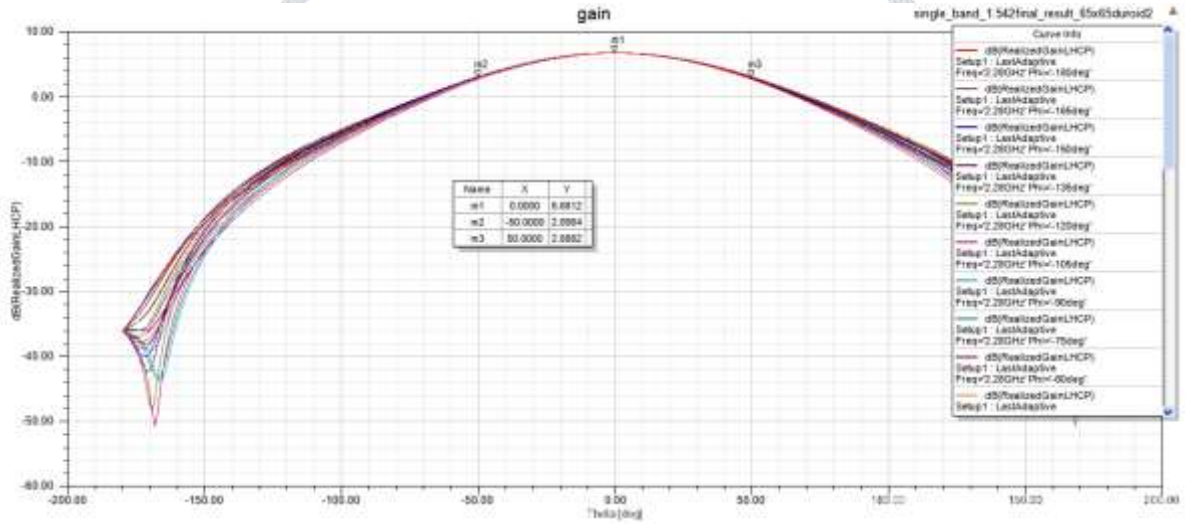

Table 2: Radiation parameters of the MPA (Design 1)

Return loss	Gain		Axial ratio	
dB	0°	-50°,50°	0°	-50°,50°
-25.7577	6.6812	2.8984	0.8377	1.3987

IV. Design of Dual Band Microstrip Patch Antenna (Design 2)

The multifrequency patch antennas found in the literature can be subdivided into two categories, namely; multiresonator antennas and reactive loading antennas. In the first kind of structure, multifrequency behavior is obtained by means of multiple radiating elements, each supporting strong currents and radiation at resonance. This category includes multilayer stacked-patch antennas fabricated by using circular, rectangular, and triangular patches. A multiresonator printed antenna can also be fabricated on a single dielectric layer by using aperture-coupled parallel rectangular dipoles.

The reactive-loading patch antenna consists of a single radiating element in which the double resonant behavior is obtained by connecting coaxial or Microstrip stubs at the radiating edge of a rectangular patch. The double-frequency behavior is obtained by means of shorting vias symmetrically located with respect to the patch axes.

Another kind of reactive loading can be introduced by etching slots on a patch. The slot loading allows to strongly modifying the resonant mode of a rectangular patch, particularly when the slots cut the current lines of the unperturbed mode.

In this paper, the dual band CP is obtained using single feed MPA with two pair of slots. One pair of slots has protruding slots which is perpendicular to the edge of the slots. An air gap has been inserted to improve the gain. The 2 pair of slots is placed to the boundary of the patch with some distance.

Figure 7: Design of MPA with two pair of slots for Dual Band Operation (Design 2)

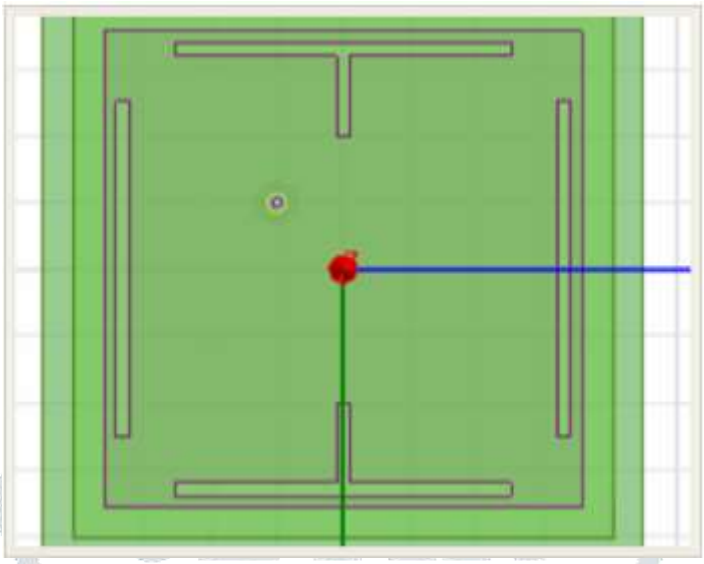

Figure 8: Design of feed for MPA proposed as Design 2

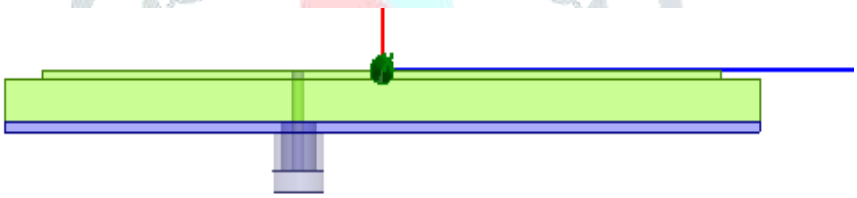

Figure 9: Simulated Graph of Return Loss of MPA proposed as Design 2

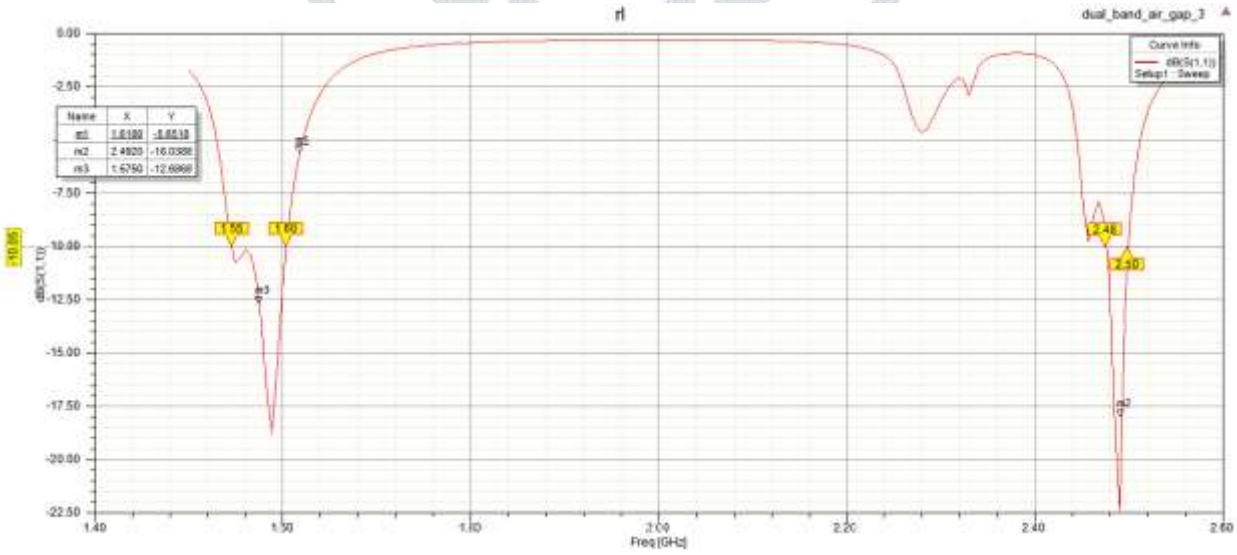

Table 3: Radiation Parameters of MPA proposed as Design 2

Operating Frequencies	Return Loss (RL)	10 dB RL bandwidth
1.575 GHz (L band)	-12.6868 dB	50 MHz
2.492 GHz (S band)	-18.0388 dB	20 MHz

V. CONCLUSION

In this paper a compact printed Microstrip patch antenna MPA which provides dual band CP operation with enhanced bandwidth has been presented. The antenna is having good selectivity at resonance frequencies of 1.575 GHz and 2.492 GHz. Dual band CP operation and bandwidth enhancement characteristics have been achieved by geometrically modifying radiating patch and loading it with two slots .

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