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Compact Via Loaded 30 Degree Sectoral Structure for GPS & Wireless Applications

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ABSTRACT
An optimized dual frequency microstrip patch antenna structure is proposed. The design is based on conical via loading and slit loading technique. In this paper, details of the antenna are discussed along with the simulated result. The simulation is based on method of moment method, using IE3D software. It is also observed that by cutting a slit in the non-radiating edge and varying the conical via location we can reconfigure the antenna resonating frequency. This antenna can operate at Bluetooth frequency and also this antenna is applied for WLAN application.
An optimized dual frequency sectoral PIFA antenna has been proposed. The design is based on conical via loading technique. In this paper, details of the sectoral antenna are discussed along with the simulated result. The simulation is based on method of moment method, using IE3D software. It is also observed that by slit loading and varying in the horizontal direction and we can reconfigure the antenna resonating frequency.

Keywords - Sectoral PIFA, Via Loaded PIFA, GPS Antenna, Dual Frequency Via Loaded PIFA

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1. INTRODUCTION

With the increase of the wireless communication systems we can notice the urge of future technologies are in need of low-profile antennas for wireless communications [1-4]. An antenna must fulfill the requirements of the user along with its respective characteristics intact.

Microstrip patch antennas are widely used for their low-profile, light weight structure which gives a minimal cost compared to other antennas. The disadvantage of microstrip patch antenna is that it gives narrow bandwidth. However, researchers have made outstanding efforts to overcome this problem and configurations have been presented to increase the bandwidth.

In this paper we have designed a 30 degree sectoral antenna that resonates in dual frequency 1.2GHz and 3GHz. We have taken the air substrate which has dielectric constant as 1 and loss tangent 0.01 having substrate thickness 3.4mm.

2. INDENTATIONS AND EQUATIONS

We have a taken an equilateral triangular microstrip antenna (ETMSA) whose length was calculated depending on the dominant mode of operation i.e m=1 and n=0 from the equation given below.

According to a theory, [5-8] we have cut the triangle (ETMSA) from zero voltage plane, which gives the structure that we are presenting in this paper.

Zero voltage plane for a triangle is cited almost along 1/3rd height from its base.

The equations are:

$$fmnl = fmn = \frac{2c\sqrt{(m^2 + mn + n^2)}}{3Se\sqrt{\in e}}$$

$$Se = S + \frac{4h}{\sqrt{\in e}}$$

For our design, $\varepsilon e = 1$ [air substrate], $f_{mn} = 2.4$ GHz

From the calculations, we have got,

The arm length of the equilateral triangle (S) = 120mm

The height of the perpendicular = 103mm (~ 105mm taken)

Here, we have achieved 1.2 GHz from 2.4GHz using sectoral cut-off as we got another resonating frequency i.e 3GHz for wireless applications after implementing second via and optimizing both the vias along with the feed point.

3. FIGURES AND TABLES

We have proceeded from larger patch to more compact patch using sectoral cut-off. The respective Figures show the path to our designed antenna.

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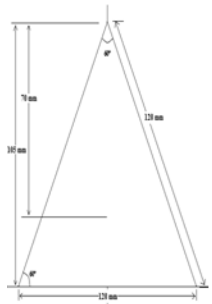


Figure 3.1

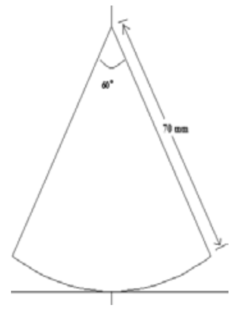


Figure 3.2

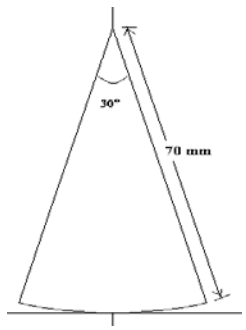


Figure 3.3

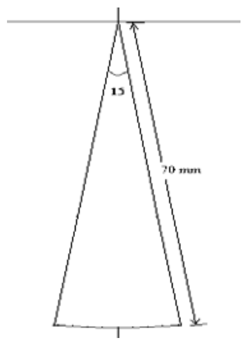


Figure 3.4

Figure 3.1 – Displays the equilateral triangle firstly desgined using empirical formulae given in Equation 3.1-3.2

Figure 3.2 – Displays the 60 degree sectoral cut from the former equilateral triangle

Figure 3.3 – Displays further 30 degree sectoral cut from former 60 degree patch to make more compact antenna (Our main proposed antenna)

Figure 3.4 – Displays experimental 15 degree sectoral anteena cannot be realized well)

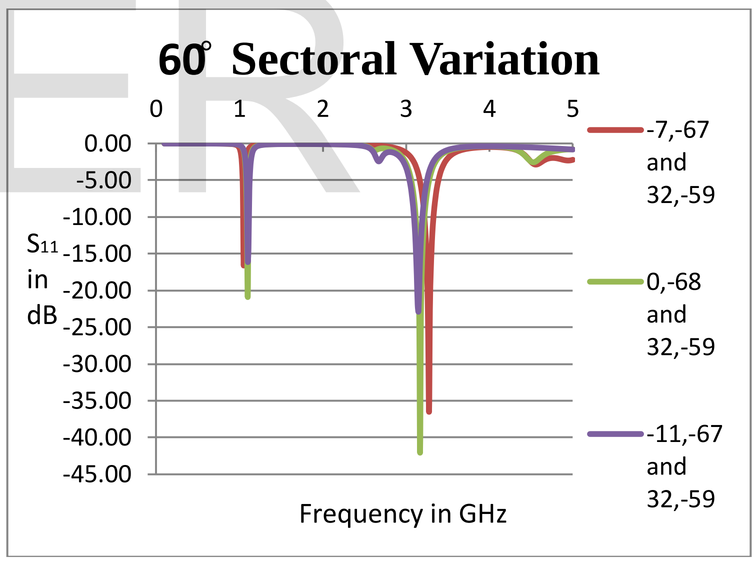
The Table 3.1 displays the best simulated results we have come across from the former equilateral triangular patch to the 30° sectoral antenna and the experimental 15° sectoral antenna. Simulations are done using IE3D [9].

Index: V1= Via location 1
V2= Via location 2
RF1= Resonating Frequency 1 (in GHz)
RF2= Resonating Frequency 2 (in GHz)
RL1= Return Loss 1 (in dB)
RL2= Return Loss 2 (in dB)

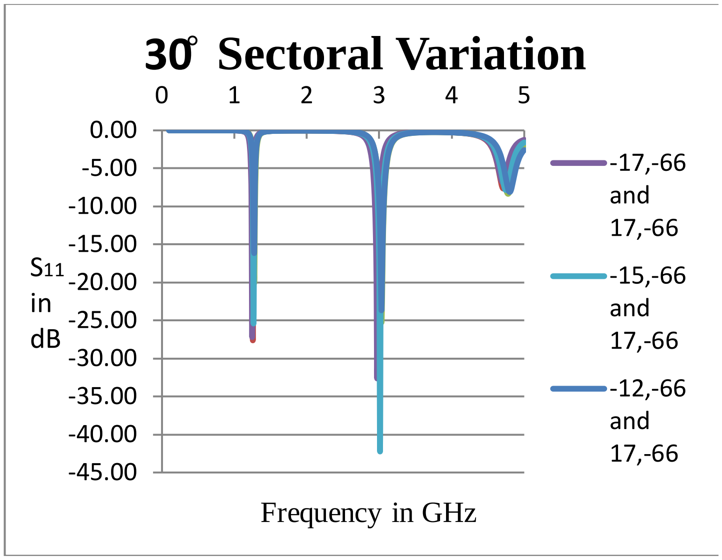
(Bold markings are the locations where we get best results compared to others)

Type of Patch	V1	V2	RF1	RF2	RL1	RL2
60° Sectoral Variation (Feed Loc =30, -61)	32, -59	-11, -67	1.143	3.127	-22	-22
	32, -59	-7, -67	1.122	3.165	-20	-35
	32, -59	**0, -68**	**1.081**	**3.27**	**-20**	**-46**
30° Sectoral Variation (Feed Loc =15, -67)	17, -66	-17, -66	1.27	2.97	-27	-28
	17, -66	**-15, -66**	**1.25**	**3.01**	**-25**	**-43**
	17, -66	-13, -66	1.21	3.02	-20	-28
15° Sectoral Variation (Feed Loc = 5, -68)	7, -69	-8, -69	1.3	3.2	-17.8	-27
	7, -69	**-7, -69**	**1.3**	**3.2**	**-26**	**-50**
	7, -69	-6, -68	1.317	3.24	-17	-22

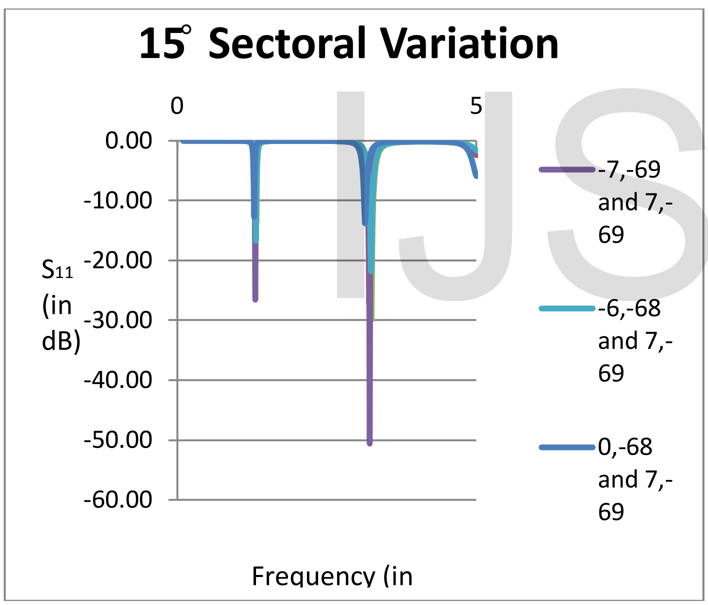
Table 3.1



Graph 3.1 – Displays the return loss of 60 sectoral variation



Graph 3.2 – Displays the return loss of 30 sectoral variation



Graph 3.3 – Displays the return loss of 15 sectoral variation

4. CONCLUSION

We have seen that the antenna being more précised in size gives better return loss i.e S11 plot. In the 60 sectoral variation we have seen the response being in . In 30 sectoral variation we have got response of . In 15 sectoral variations we have got dual frequency response at which implies better return plot. This antenna can be used for GPS as well as wireless applications.

Our further study will follow the miniaturization of our antenna keeping the sectoral fixed and making the arm lengths variation. We will study if it gives better response at proper frequencies or not.

We are trying to develop a small sized pifa sectoral antenna with minimum area so that it can be used in single device for multiple frequencies using MIMO switches.

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