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# Equilateral Triangular Microstrip Patch Antenna using Different Substrates

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## I. INTRODUCTION

Compact micro strip antennas have recently received much attention due to the increasing demand of small antennas for personal as well as commercial communication equipment. It has been demonstrated that equilateral triangular micro strip patch can effectively reduce the required patch size for a given operating frequency [1]. In mobile communication system such as satellite, RADAR, Global Position System (GPS) often require extremely small size, light weight. The 'C' band of frequency is used for the satellite communication and terrestrial application.

Single band & Dual band frequency operation of triangular micro strip antennas have been studied by Many researchers using coaxial probe feed [1]-[2]. This paper reports the simulation result using equilateral triangular patch antenna with co-axial feed. This paper therefore proposed a design of single & dual band operation of equilateral triangular micro strip antenna using HFSS (high frequency structure stimulator) which is commercially available in the market and the it depend on the FEM(finite element method ) analysis.

## II. ANTENNA GEOMETRY

The geometry of the proposed triangular antenna using a co-axial probe feed is shown in fig.1. The proposed antenna is constructed on a dielectric substrate on different substrates such as:

1. Rogers RT/duriod 5880(TM) which has a dielectric constant 2.2, & loss tangent 0.0009.
2. FR-4 EPOXY which has a dielectric constant 4.4, & loss tangent 0.002

3. Rogers TMM6 which has a dielectric constant 6, & loss tangent 0.0023.
4. Rogers RT/duriod 6010/6010 LM(TM) which has a dielectric constant 10.2, & loss tangent 0.0023.

The area of the equilateral triangular patch antenna is situated on the substrate with dimension  $1/2(31.1*26.97779)$  mm<sup>2</sup>. Height of substrate is 4mm.

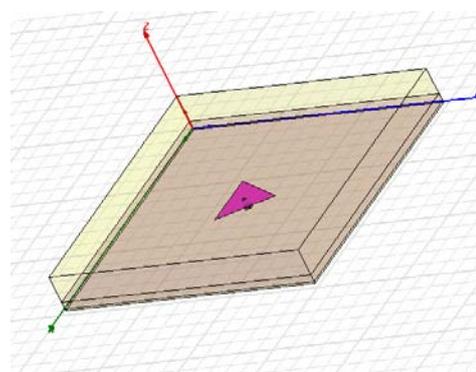


Figure 1: Antenna Geometry

## III. SIMULATION RESULT

### a) Rogers RT/duriod 5880(TM)

The impedance bandwidth of proposed antenna at the centre frequencies is shown in Fig. 2.1. This result shows single band width below to the -10dB so we can operate this antenna in the single bands and the return loss is -19.67dB. Proposed antenna can operate efficiently at frequency 3.42GHz. impedance Bandwidth achieved by this antenna is 34.23%. The VSWR is 1.26.

The impedance bandwidth and VSWR shows in fig. 2.1 & fig 2.2 and we can see here the antenna have resonance at 3.42GHz. The radiation pattern is shown in fig 2.3 which shows the antenna is unidirectional. By varying the position of coaxial probe for the input impedance matching of the feeding system can be characterized.

Furthermore, the radiation pattern of the proposed antenna is also measured with respect to gain. The radiation pattern of the antenna is shown in Fig. 2.3. Smith chart is shown in fig 2.4.

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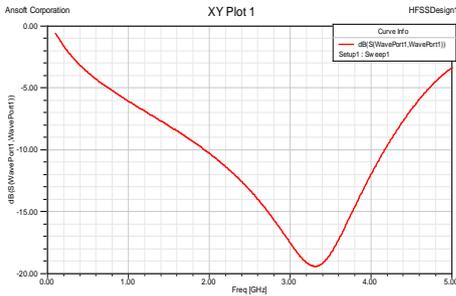


Figure 2.1: Measured impedance bandwidth

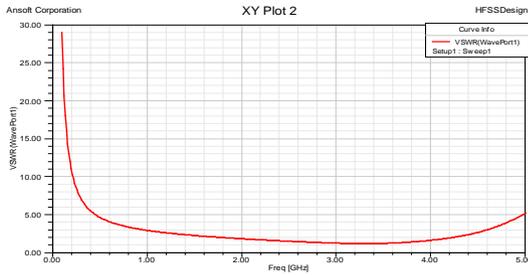


Figure 2.2: Measured VSWR

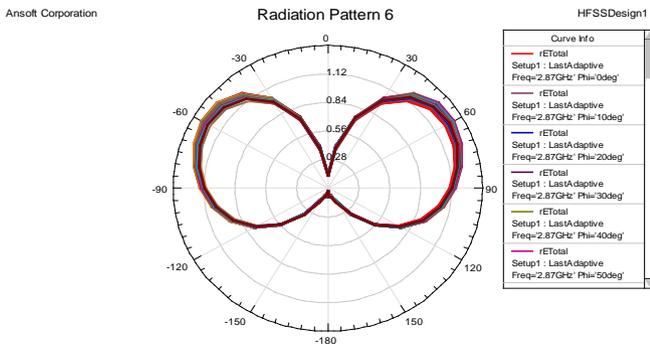


Figure 2.3: Radiation pattern 2D

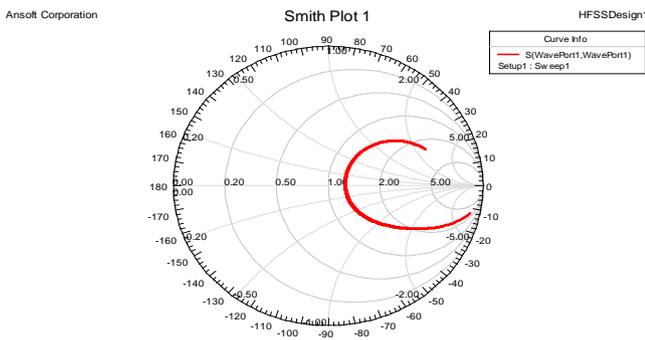


Figure 2.4: Input impedance loci using smith chart

b) FR-4 Epoxy

When we use FR-4 EPOXY as substrate the measured return loss is -18dB & impedance bandwidth is 32%. In this case measured VSWR is 1.24 & resonance frequency is 2.9 GHZ. Measured return loss,

VSWR, radiation pattern, and smith chart is shown in fig.3.1-fig 3.4.

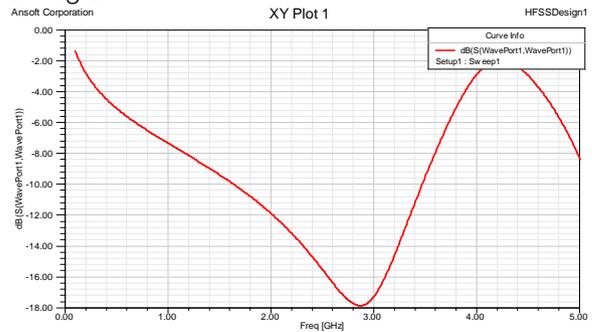


Figure 3.1: Measured impedance bandwidth

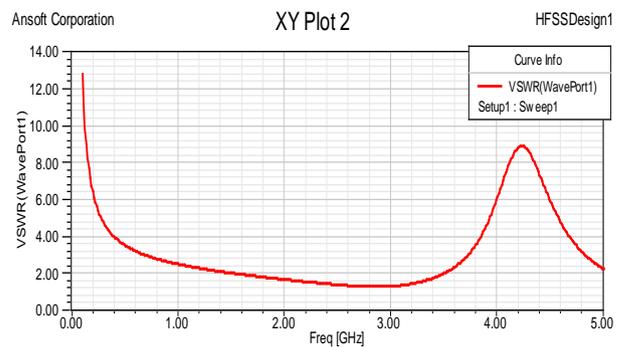


Figure 3.2: Measured VSWR

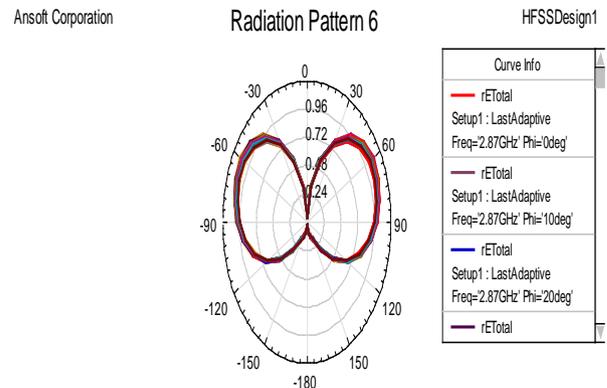


Figure 3.3: Radiation pattern

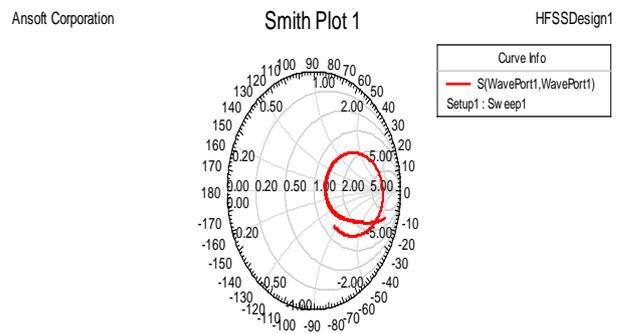


Figure 3.4: Input impedance loci using smith chart

c) Rogers TMM6

By using Roger TMM6 as substrate dual band has achieved which is resonant at 2.68 GHz and 4.88GHz .in this case the measured return loss is -17.43dB & -20.33dB respectively. impedance bandwidth is 30.85% & 6.25% resp.. In this case measured VSWR is 1.34 & 1.16 resp. Measured return loss, VSWR, radiation pattern, and smith chart is shown in fig.4.1-fig 4.4.

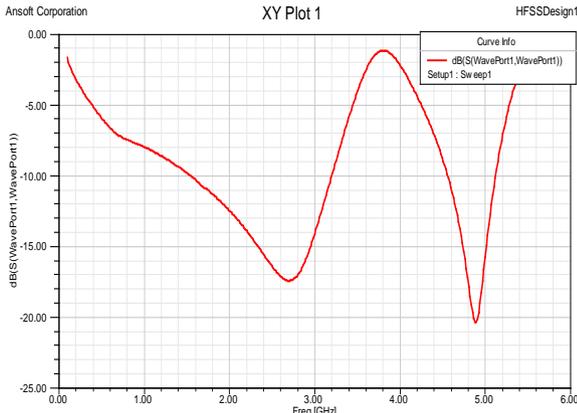


Figure 4.1: Measured impedance bandwidth

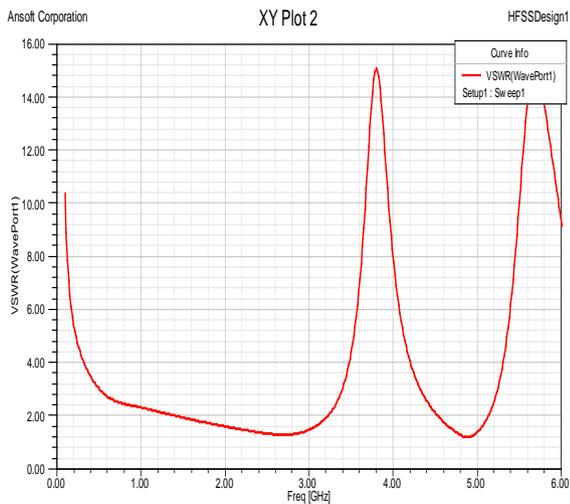


Figure 4.2: Measured VSWR

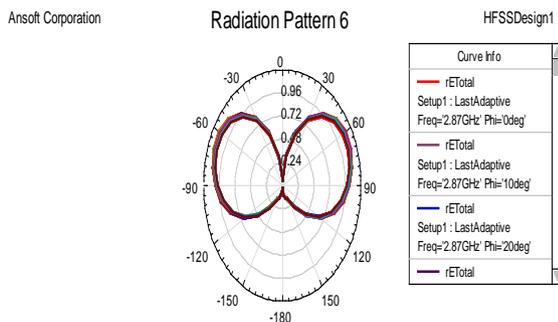


Figure 4.3: Radiation pattern

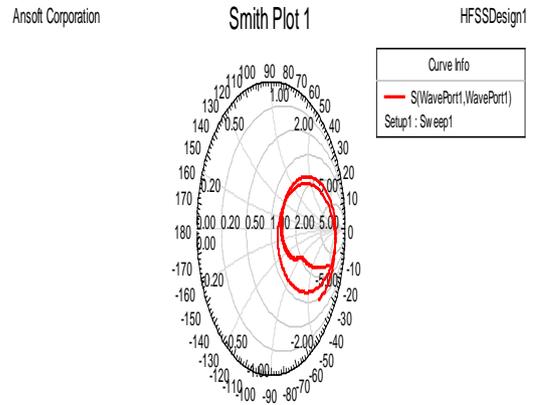


Figure 4.4: Input impedance loci using smith chart

d) Rogers RT/duroid 6010/6010 LM(TM)

Dual band operation can also be achieved by using Rogers RT/duroid 6010/6010LM(TM).

In this case resonant frequencies are 2.29GHz & 3.87GHz.measured return losses are -16.1dB & -20.33Db.

Impedance bandwidth 27% & 6.47%resp.VSWR measured are 1.37 & 1.13 resp. Measured return loss, VSWR, radiation pattern, and smith chart is shown in fig.5.1-fig 5.4.

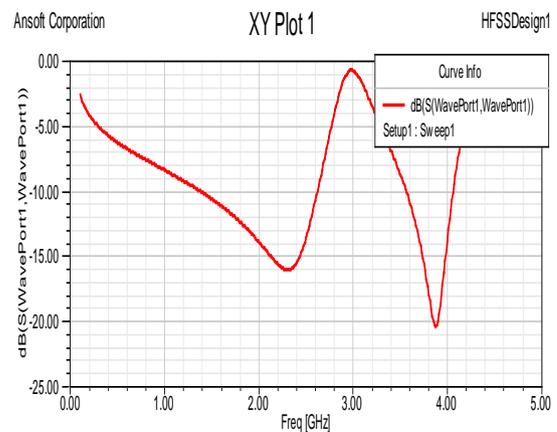


Figure 5.1: Measured impedance bandwidth

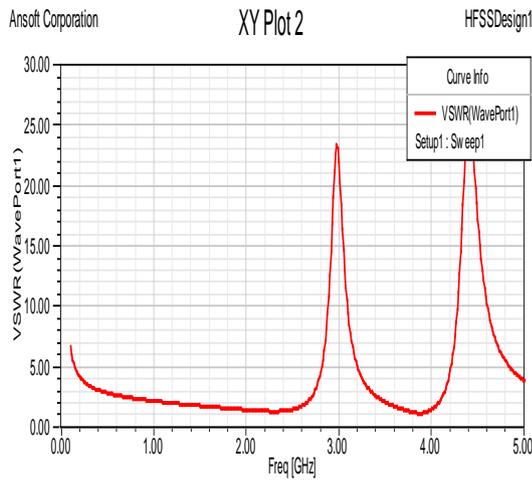


Figure 5.2: Measured VSWR

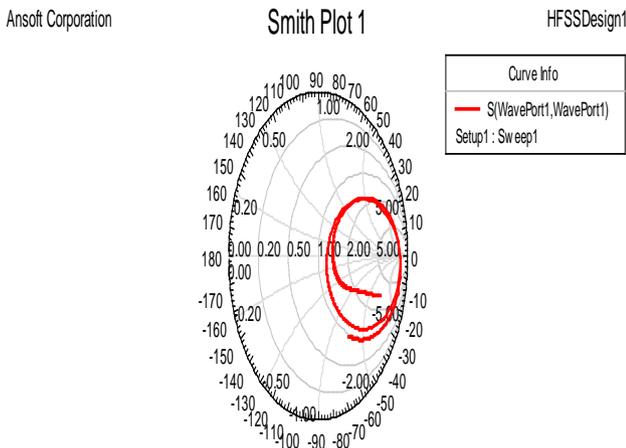


Figure 5.3: Input impedance loci using smith chart

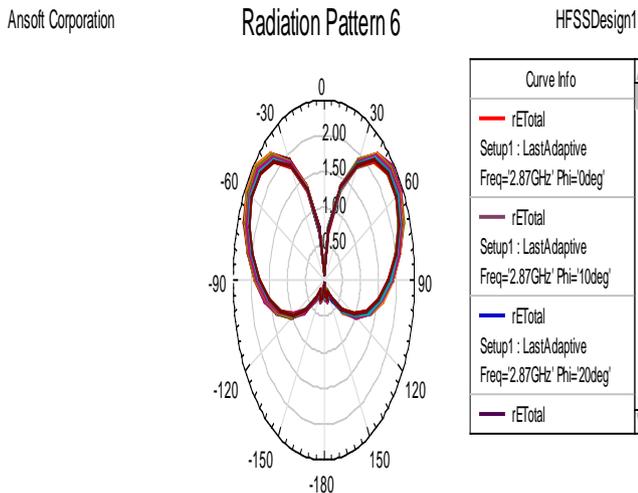


Figure 5.4: Radiation pattern

Table: Comparison table

	Resonant frequency	Return losses	Bandwidth	VSWR
$\epsilon_1=2.2$	3.42GHz	-19.67 dB	34.23%	1.26
$\epsilon_2=4.4$	2.90 GHz	-18 dB	32%	1.24
$\epsilon_3=6.0$	2.68 GHz	-17.43 dB	30.85%	1.34
	4.88 GHz	-20.33 dB	6.25%	1.16
$\epsilon_4=10.2$	2.29 GHz	-16.10 dB	27%	1.37
	3.87 GHz	-20.33 dB	6.47%	1.13

- $\epsilon_1$ - Rogers RT/duriod 5880(TM)
- $\epsilon_2$ - FR-4 EPOX
- $\epsilon_3$ - Rogers TMM
- $\epsilon_4$ - Rogers RT/duriod 6010/6010 LM(TM)

#### IV. CONCLUSION

From Comparison table we observe that as we increase the permittivity of substrate, resonance frequency & bandwidth are decreases, and return losses increases. From results we concluded that proposed equilateral triangular patch antenna with co-axial probe feed gives better performance with substrate whose permittivity is 2.2(Rogers RT/duriod 5880(TM)).Which can be used in C-band operation.

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