Design and Simulation of E shape L slot Microstrip Patch Antenna with different substrates for Wireless Communication

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Abstract

The area of microstrip antennas has seen some inventive work in recent years and is one of the most dynamic fields of antenna theory. In this paper we have proposed configuration of patch antenna having E shape L slot patch. Performance of patch antenna is characterized by return loss & gain. Different substrates are used to get an improved gain and return loss.

Keywords

Microstrip Patch, E shape L slot, HFSS, Gain, Return Loss

I. Introduction

Due to advancement in wireless communication many high performance devices are designed which require higher speed and ease of installation. In spacecraft or aircraft applications, where size, weight, cost, performance, ease of installation, and aerodynamic profile are constraints, low profile antennas are required. In order to meet these specifications Microstrip Patch antennas are used. These antennas can be flush mounted to metal or other existing surfaces and they only require space for the feed line which is normally placed behind the ground plane. The major disadvantages of patch or microstrip antennas are their inefficiency and very narrow bandwidth which is typically only a fraction of a percent or at the most a few percent. [1]

II. Antenna Design

Here we discuss the design of E shape L slot patch antenna and this design is simulated with the help of HFSS software.

The design of E-shape L-slot patch antenna is shown in fig.1 given below

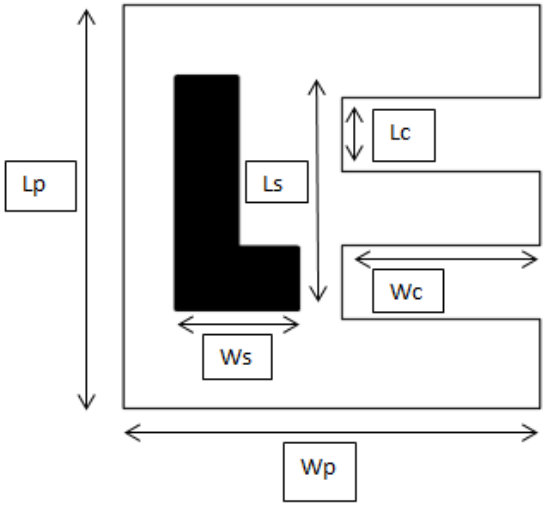

Fig.1

Here in this section an E shape L slot antenna is designed and simulated with the help of HFSS at an resonant frequency *fo=10ghz* and the patch dimensions are as follows.

Lp = 25mm, Wp = 15mm, Lc = 1mm, Wc = 9.3mm, Ls = 18mm, Ws = 7mm

Here Lp denotes length of patch, Wp denotes width of patch, Ls denotes length of L slot, Ws denotes width of L slot, Lc denotes length of E cut and, Wc denotes width of E cut. The feed is applied to antenna at (-4.8mm,0mm,0mm). The feed applied to antenna is made up of the pec . This feed point is obtained after the optimetric analysis of patch. Now here the dimensions of the patch antenna are kept same but the different substrates are used with different relative permittivity. The dimension of the substrate are kept same i.e. 60×60×3.2

MATERIAL 1

Design of an antenna using substrate having relative permittivity of 1.5 and dimensions of substrate are 60×60×3.2 we get return loss of -14.4286db and gain of 5.4737db. The plot for return loss , gain, and 3d polar plot is shown in fig 2, fig 3,fig 4 respectively.

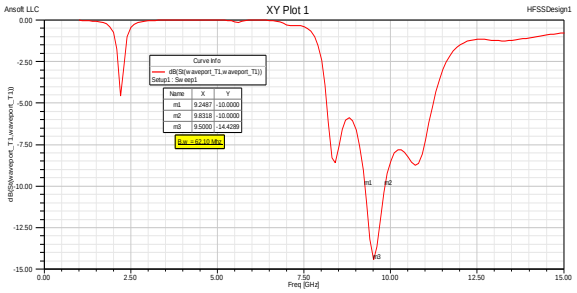

Fig.2 (Return Loss)

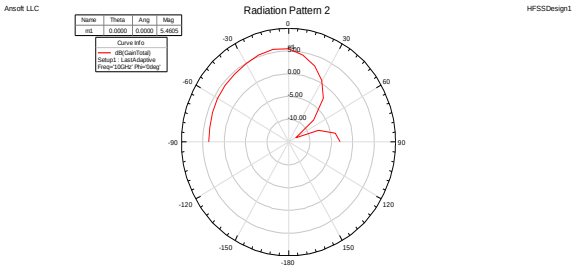

Fig.3 (Gain Total)

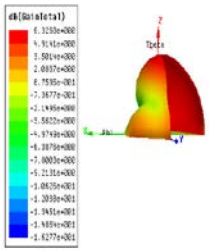

Fig. 4(3d Polar Plot)

ROGERS RT/DUROID 5870(tm)

Simulation results of antenna with help of Hfss using this substrate gives the return loss of -18.5937db and an improved gain of 5.6741db. The plot for return loss, gain, and 3d polar plot is shown in fig 5, fig 6,fig 7 respectively.

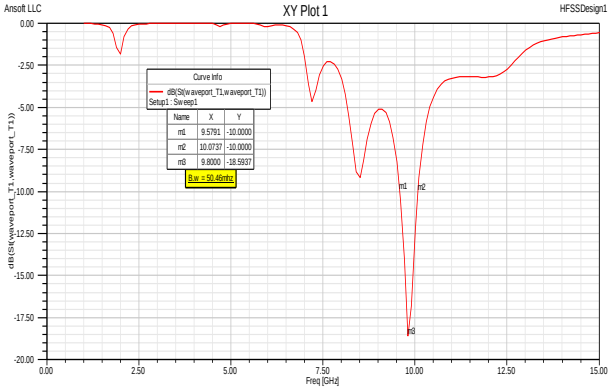

Fig.5 (Return Loss)

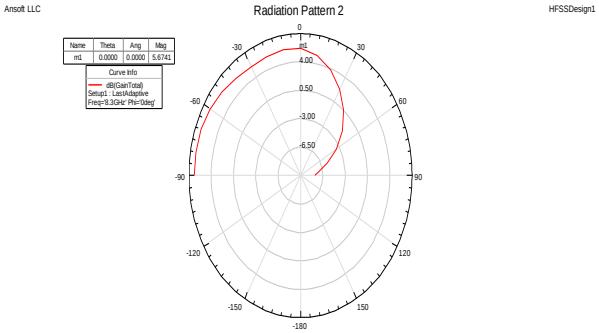

Fig.6 (Gain Total)

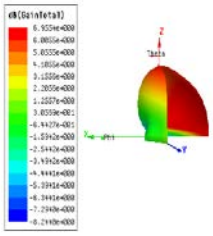

Fig.7

(3d Polar Plot)

AIR

Simulation of patch antenna using air as substrate gives the improved gain of 6.5782 db and bandwidth of 62.47 mhz. the return loss of antenna is -16.3287 db. The plot for return loss , gain, and 3d polar plot is shown in fig 8, fig 9,fig 10 respectively.

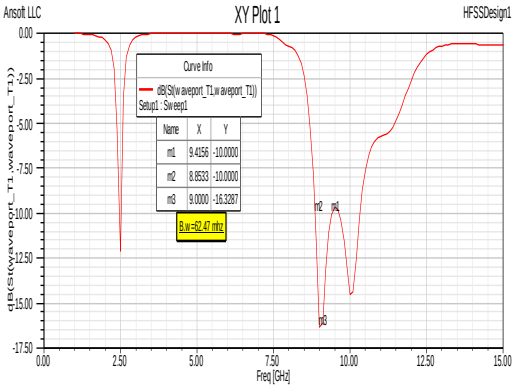

Fig.8 (Return Loss)

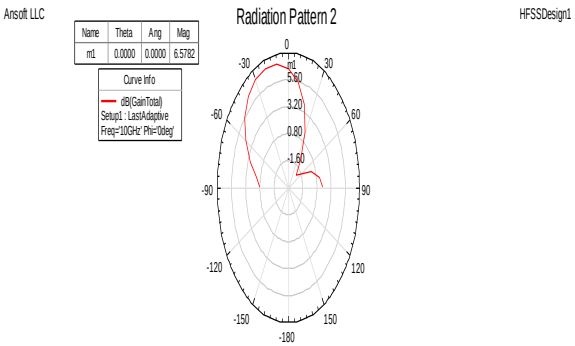

Fig.9 (Gain Total)

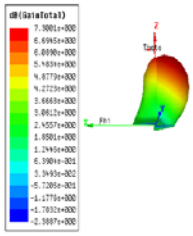

Fig.10 (3d Polar Plot)

MATERIAL 2

Here we add a new material having relative permittivity of 1.1 and the simulation of patch antenna using such substrate gives the gain of 7.0359db and we obtained a dual band one is of 54.62 Mhz. and other is of 67.03 Mhz. The plot for return loss , gain, and 3d polar plot is shown in fig 11, fig 12,fig 13 respectively.

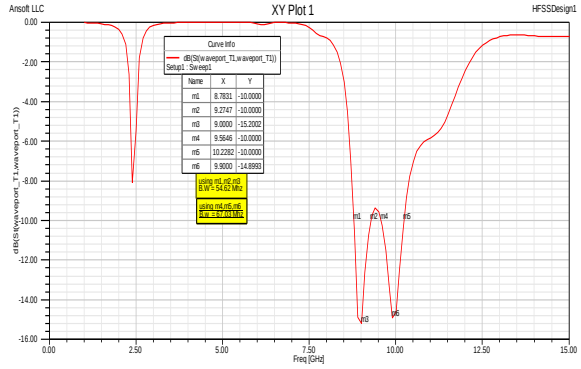

Fig.11 (Return Loss)

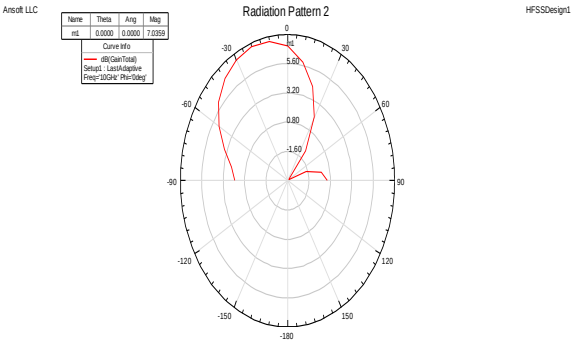

Fig.12 (Gain Total)

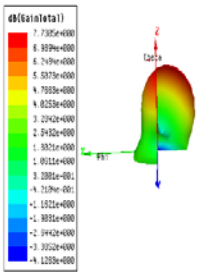

Fig.13 (3d Polar Plot)

III. Comparative Analysis

Here in this section the comparison of results is done that is obtained using different substrates of micro strip patch antenna and given by table 1.

Parameter	Material 1	Rogers RT/Duroid 5870	Air	Material 2
FL(Ghz)	9.2487	9.5791	8.853	9.546
FH(Ghz)	9.8318	10.0737	9.415	10.2282
F0(Ghz)	9.500	9.8000	9.000	9.900
B.W (Mhz)	62.10	50.46	62.47	67.03

Return Loss(db)	-14.42	-18.593	-16.328	-14.899
Gain(db)	5.4605	5.6741	6.578	7.0359

Table.1 (Comparison of results of all antennas with different substrates.)

IV. Conclusion

After simulation we found that the E-shape L- Slot Patch antenna having substrate of material 2 i.e. having relative permittivity of 1.1 have higher gain as well as obtained bandwidth as compared to the E-shape L- slot patch antenna with substrates as air , rogers rt/duroid 5870 or material 1 having permittivity of 1.5.

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