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Feeding position Effects on the performance of Planar Inverted Folded Antenna

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ABSTRACT

PIFA's are used in many applications like PCS, mobile handsets, Bluetooth, WLAN, WI-FI etc. The position of the feed and the patch dimension will play a major role in the performance of the antenna along with substrate, material. The method of improving the bandwidth and reduction of size of the antenna can be alone carried by selecting these PIFA antennas. The design and characterization of the PIFA with respect to the feeding position is to be analyzed in this present work. Different feeding positions are considered and verified the output parameters of the antenna and analyzed the results.

Keywords: Feeding Position, Planar Inverted Folded Antenna, PCS, WLAN, Wi-Fi

INTRODUCTION

The planar Inverted antenna consists of a rectangular element located above round plane with a feeding mechanism. The Omni directional behavior of the planar inverted folded antennas with gain values ensures the performance for typical indoor environment by considering receive sensitivity and range of radio devices [1-4].

The PIFA antenna exhibits elliptical polarization than circular polarization. The axial ratio of this antenna nearly reaches to 20 dB and this PIFA antenna nearly can be mounted in any surface or device by its adaptable nature [5-8]. The considerations for the PIFA antenna are:

- The PIFA bandwidth increases with the thickness.
- The input impedance can be arranged to have an appropriate value without using any additional circuit.

The advantage of the PIFA antennas are, It reduces the backward radiation towards the user head when it is mounted in the mobile sets. The gain of the PIFA antenna is very high in both vertical and horizontal states of polarization. The only limitation for this PIFA antenna is the narrow band characteristics [9-12].

The resonant frequency of PIFA can be approximately with:

L1+L2=lambda/4
When W/L1=1, then L1+H=lambda/4
When W=0, then L1+L2+H=lambda/4

The present paper deals with the performances of the PIFA antenna by changing its feed length. In this work, we considered five different feeding lengths and at each value of the feed length, we observed the antenna parameters and the performance characteristics thoroughly.

RESULTS AND DISCUSSION

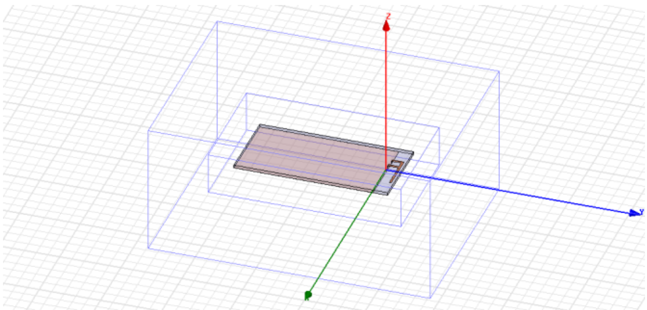

Figure (1) PIFA Antenna Model

The figure (1) shows the basic PIFA antenna model designed and generated using commercial antenna designing and simulating software ANSOFT HFSS. The patch is placed above the ground plane and the substrate with some air gap between the path and the substrate material. The dimension of the patch seems to be like inverted F-shape as shown in the figure (1). Figure (2) and (3) shows the return loss and VSWR curves for the proposed antenna.

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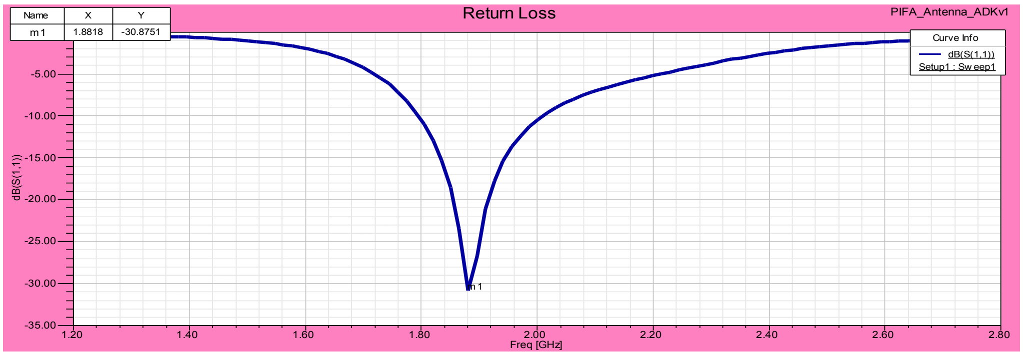

Figure (2) Return loss Vs Frequency

Table (1) Antenna Dimensions

Sno	Solution frequency	Antenna length	Antenna width	Feed length
1	1.9GHZ	31.5mm	1.9mm	0.1mm
2	1.9GHZ	31.5mm	1.9mm	0.5mm
3	1.9GHZ	31.5mm	1.9mm	1mm
4	1.9GHZ	31.5mm	1.9mm	1.5mm
5	1.9GHZ	31.5mm	1.9mm	2mm

Table (1) shows the antenna dimensions at fixed frequency of 1.9Hz, the antenna length and width are same throughout the work but the feed length is chosen at different values like 0.1mm, 0.5mm, 1mm, 1.5mm, 2mm

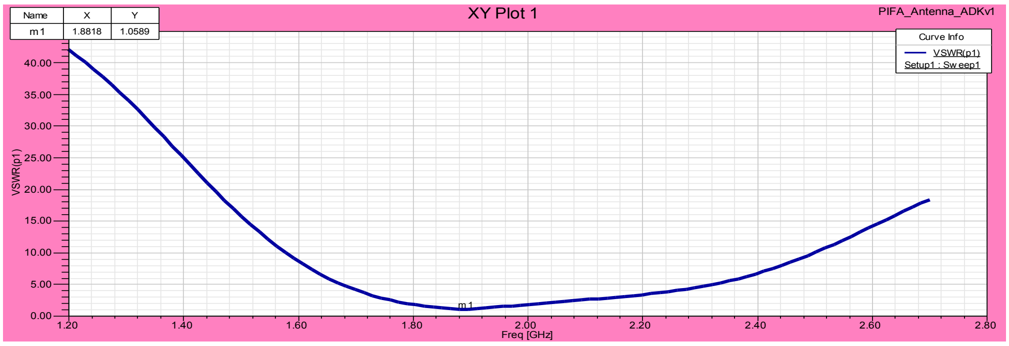

Figure (3) VSWR Vs Frequency

Table (2) Antenna Parameters

Sno	Feed length	Return loss	Rms	% of BW	Gain
1	0.1mm	-37.056dB	.701	84.2%	4 dB
2	0.5mm	-30.87 dB	.704	87.1%	3.95 dB
3	1mm	-43.79 dB	.702	85.4%	3.86 dB
4	1.5mm	-37.80 dB	.706	86.31%	3.89 dB
5	2mm	-39.40 dB	.7024	86.12%	3.884 dB

Table (2) gives the antenna parameters of different feed lengths. At 0.1mm a return loss of -37.056dB and rms of 0.701 is obtained . The % of bandwidth is up to 84% and the gain is about 4dB.By observing from table (2) it is found that a least value of return loss is obtained for the case of 0.5mm feed length ,but when it comes to the % of bandwidth improvement, this case is showing better result of 87% among other cases. The gain of 3.86dB is obtained for the case of 1mm feed length which is the lower gain among all the other cases. So over all maximum gain is attained for the case of 0.1mm feed length and minimum gain is obtained for the case of 1mm feed length. As per the return loss is concerned, 1mm feed length is having superior value among the others.

Table (3) Antenna Additional Parameters

s.no	Quantity	Value/units at 0.1mm	Value/units at 0.5mm	Value/units at 1mm	Value/units at 1.5mm	Value/units at 2mm
1	Max u	0.19635 w/sr	0.19791w/sr	0.1924w/sr	0.19455 w/sr	0.1933 w/sr
2	Peak directivity	2.4973	2.5037	2.469	2.4796	2.4681
3	Peak gain	2.4782	2.4944	2.4497	2.4678	2.4527
4	Peak Realized gain	2.4675	2.4871	2.4179	2.4448	2.4296
5	Radiated power	0.98807 w	0.99335w	0.97929	0.98598	0.98439
6	Accepted power	0.99509 w	0.99708w	0.98699	0.99071	0.99056
7	Incident power	1 w	1 w	1	1	1
8	Radiation efficiency	0.99235	0.99626	0.9922	0.99523	0.99377
9	Front to back ratio	1.9471	1.9354	1.8583	1.931	1.8313

Table (4) Maximum Field Data

Sno	rE field	Max. Field data for length=0.1mm			Max. Field data for length=0.5mm			Max. Field data for length=1mm			Max. Field data for length=1.5mm			Max. Field data for length=2mm		
		Value/ units	At pi	At theta	Value/ units	At pi	At theta	Value/ units	At pi	At theta	Value/u nits	At pi	At theta	Value/u nits	At pi	At theta
1	Total	12.168 v	100 deg	-38 deg	12.216 v	105 deg	-38 deg	12.045v	100 deg	-38 deg	12.112v	105 deg	-32 deg	12.074v	100 deg	-38 deg
2	X	8.9509 v	60 deg	-92 deg	8.93 v	60 deg	-92 deg	8.8755v	60 deg	-32 deg	8.928v	60 deg	-92 deg	8.9341v	60 deg	-92 deg
3	Y	10.091 v	150 deg	-124 deg	10.14 v	150 deg	-124 deg	10.066v	150 deg	-124 deg	10.104v	150 deg	-124 deg	9.9999v	150 deg	-124 deg
4	Z	8.398 v	105 deg	-50 deg	8.4066 v	105 deg	-50 deg	8.3321v	105 deg	-50 deg	8.3498v	105 deg	-50 deg	8.3424v	105 deg	-50 deg
5	Pi	11.285 v	150 deg	-94 deg	11.318 v	150 deg	-94 deg	11.203v	150 deg	-34 deg	11.269v	150 deg	-94 deg	11.162v	150 deg	-94 deg
6	Theta	11.934 v	105 deg	-38 deg	11.971 v	105 deg	-38 deg	11.841v	105 deg	-38 deg	11.881v	105 deg	-38 deg	11.846v	105 deg	-38 deg
7	LHCP	10.112 v	115 deg	-42 deg	10.193 v	115 deg	-42 deg	9.9209v	115 deg	-42 deg	10.07v	115 deg	-42 deg	9.9616v	115 deg	-42 deg
8	RHCP	10.275 v	110 deg	-140 deg	10.343 v	110 deg	-140 deg	10.113v	110 deg	-140 deg	10.306v	110 deg	-140 deg	10.162v	110 deg	-140 deg

Table (4) shows the antenna maximum field data for different feed lengths .The maximum field data table is giving rE field values for all the cases of antenna dimensions with respect to the variation in the feed lengths.

CONCLUSION

PIFA antenna is simulated by choosing different feed lengths for a fixed frequency and presented with all the antenna parameters. The feed length of 0.5mm is showing superior performance over other cases and antenna additional parameters and maximum field data is also presented in this work with tabular forms. By changing the feed length the input impedance will vary for each case and the input impedance bandwidth values are exposed with rms values and gain in this present work. This work will tell the performance of the PIFA antenna with change in the feed length and how the impedance will vary for each case and at which case the impedance matching will occur are presented.

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