Study of PIFA antenna with shorting pin and plate

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Abstract:- This paper studies the Planar Inverted F- antennas and compares its results with PIFA shorting pin and PIFA shorting plate. All antennas are designed at 2.45 GHz on FR4 substrate. The directivity of the antennas is found to be 2.51dB, 6.45 dB and 3.87 dB respectively. The papers shows the surface current along the patches of the antenna.

Keywords: PIFA, shorting pin, Multi- input Multiple output (MIMO), Surface absorption rate (SAR)

Introduction

For wireless handheld devices and cellular mobile communication, the Micro strip Patch Antennas are preferably selected mainly because of their low profile characteristics, portable structure and low cost. But still they have the area to improve their bandwidth and to reduce their size, to make these more compact. Thus, Planar Inverted-F Antennas (PIFA) has come into interest. The Planar Inverted-F Antenna (PIFA) can be observed as evolved from two well known antennas, namely quarter-wavelength monopole and rectangular micro strip patch antenna. Now, PIFA is widely used in handheld and mobile applications due to its attractive features such as simple design, low-profile, lightweight, low-cost, conformal nature, relatively low specific absorption rate (SAR) and good performance [1, 2]. PIFA is also considered as one of the powerful candidates for multiple input multiple output (MIMO) systems [3].

PIFA

Planar Inverted F antenna is developed from mono pole antenna. Inverted L is realized by folding down the mono pole in order to decrease the height of the antenna at the same time maintaining identical resonating length. When feed is applied to the Inverted L, the antenna appears as Inverted F. The thin top wire of Inverted F is replaced by planar element to get the Planar Inverted F antenna. PIFA consists of ground plane, radiating patch above the ground plane and shorting plane.

There are many advantages of using PIFA antennas in handheld mobile devices. Some of these advantages are easy fabrication, simple structure, small volume, low manufacturing cost, easy to hide in the casing of the mobile handset as compared to other types of antennas. Moreover, PIFA has less backward radiation towards user's head and body which results in improved performance [1]. PIFA antennas can resonate at much smaller antenna size and resonance can be adjusted by cutting slots in radiating patch. Multiband operation can be achieved by proper shape of the patch and positions of feed plate and shorting pin [2]. Moreover, PIFA antennas introduce a solution to the effect of mutual coupling on the performance of the system through the use of a single-structure antenna that optimally produces different radiation modes.

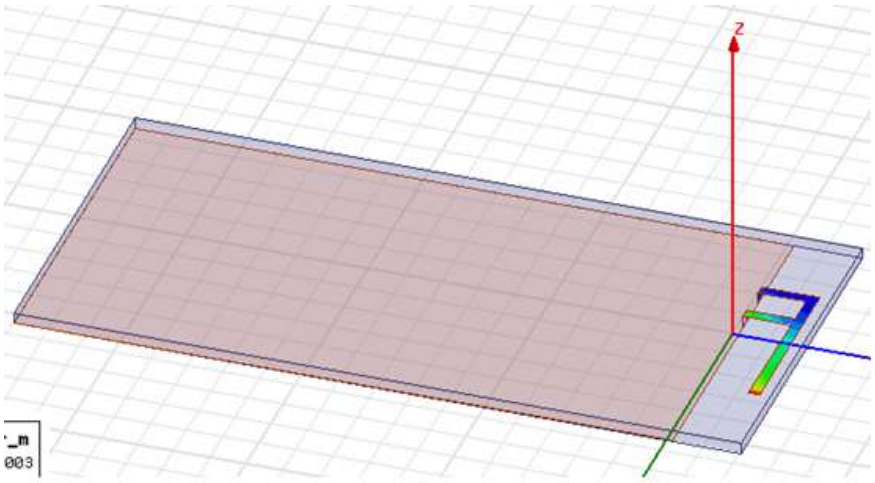

Figure 1: Design of the PIFA antenna

The figure 2 shows the return loss of the PIFA antenna from which it can inferred that the antenna resonates well.

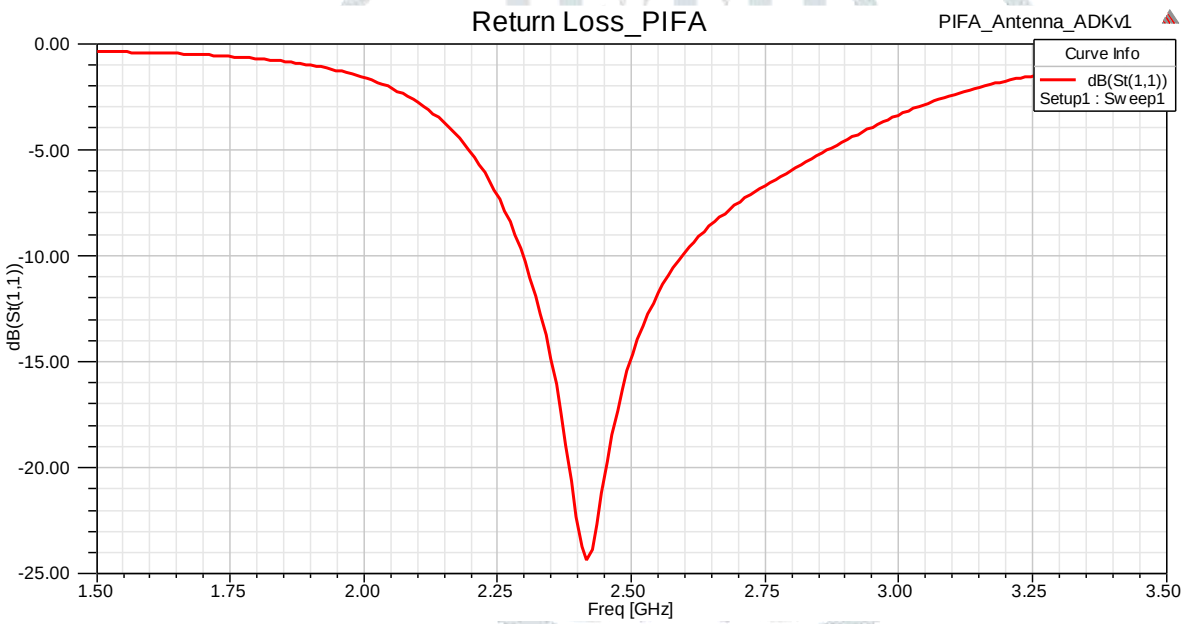

Figure 2: Return loss of the antenna

PIFA with Shorting Pin:-

To increase the antenna parameters, PIFA with a shorting pin is made. A pin is inserted through the patch to the ground so that PIFA characteristics specially gain are improved. Figure 3 shows the PIFA with the shorting pin.

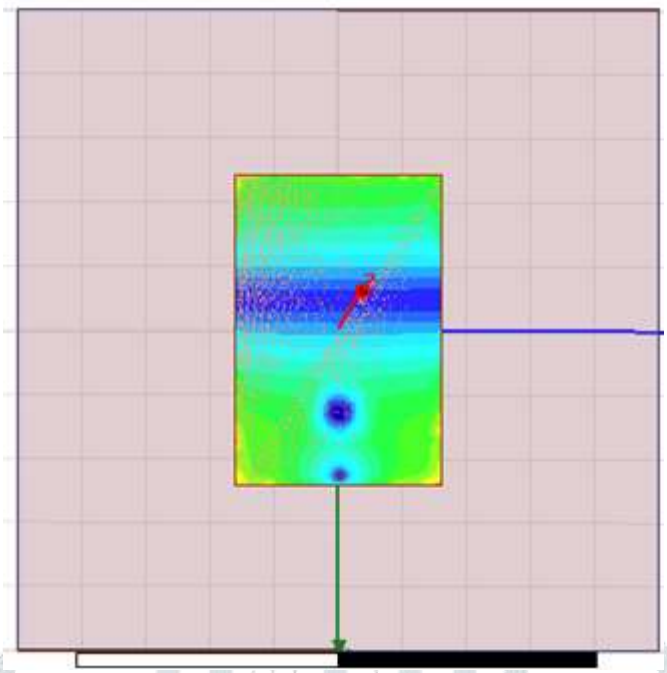

Figure 3: PIFA with shorting pin

Figure 4 shows the return loss of PIFA with shorting pin antenna.

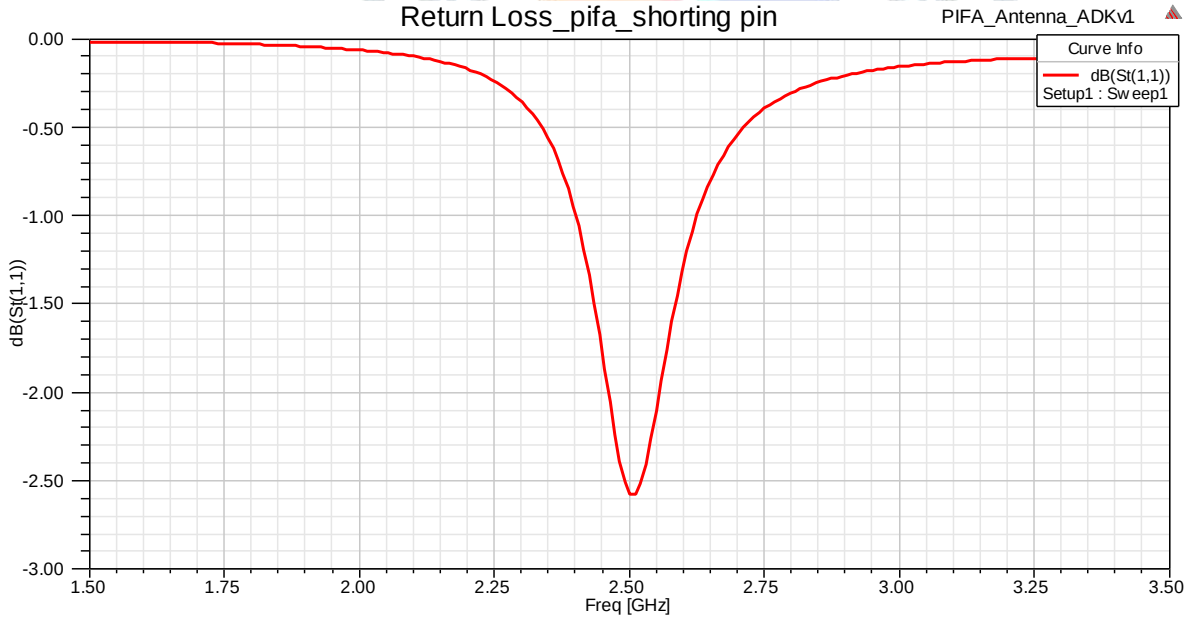

Figure 4: PIFA with shorting pin.

Figure 5 shows the gain of the antenna which is above 5 dB.

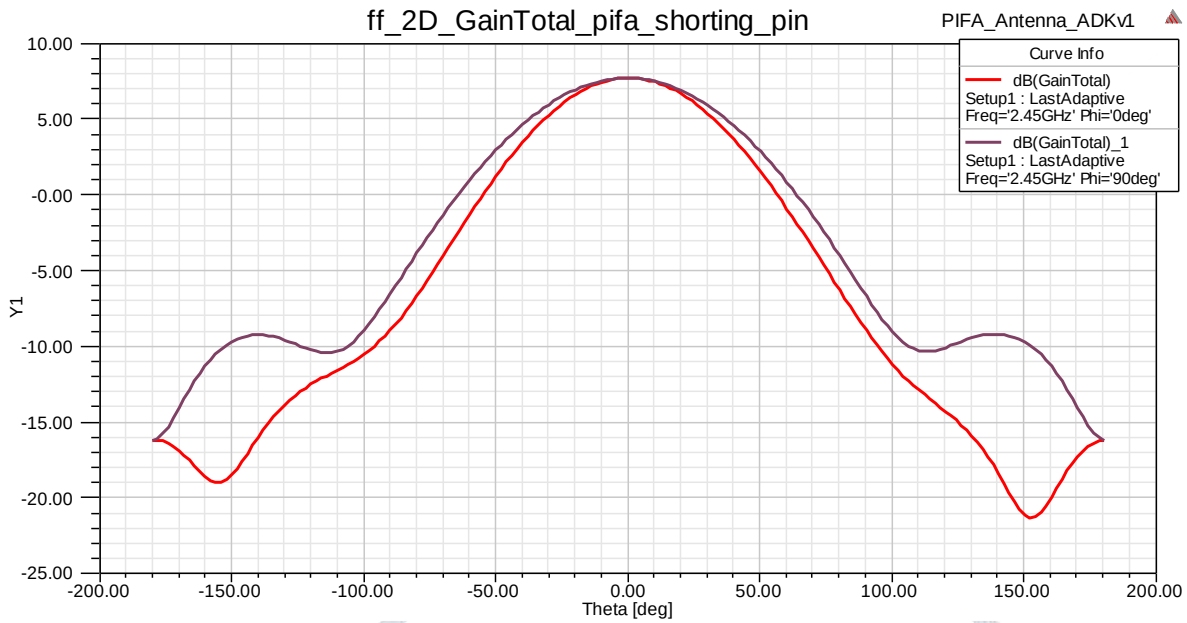

Figure 5: 2D Gain of PIFA with shorting pin.

PIFA With shorting Plate:-

Since it was a bit difficult to deal with the shorting pin as it may lead to some undesired capcitances, so the author has switched to PIFA with shorting plate. Figure 6 shows the PIFA with shorting plate.

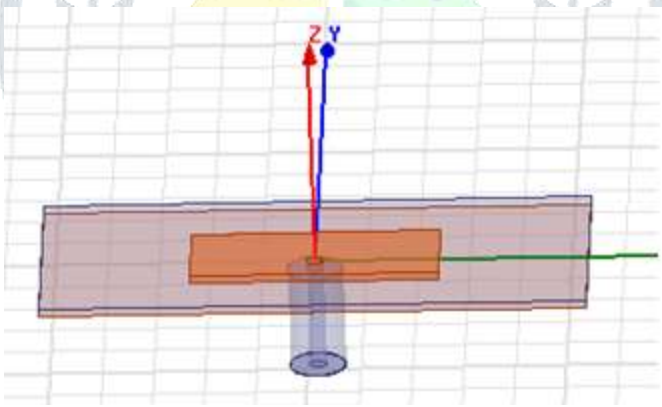

Figure 6: PIFA with shorting plate

Figure 7 shows the return loss of the PIFA with the shorting plate.

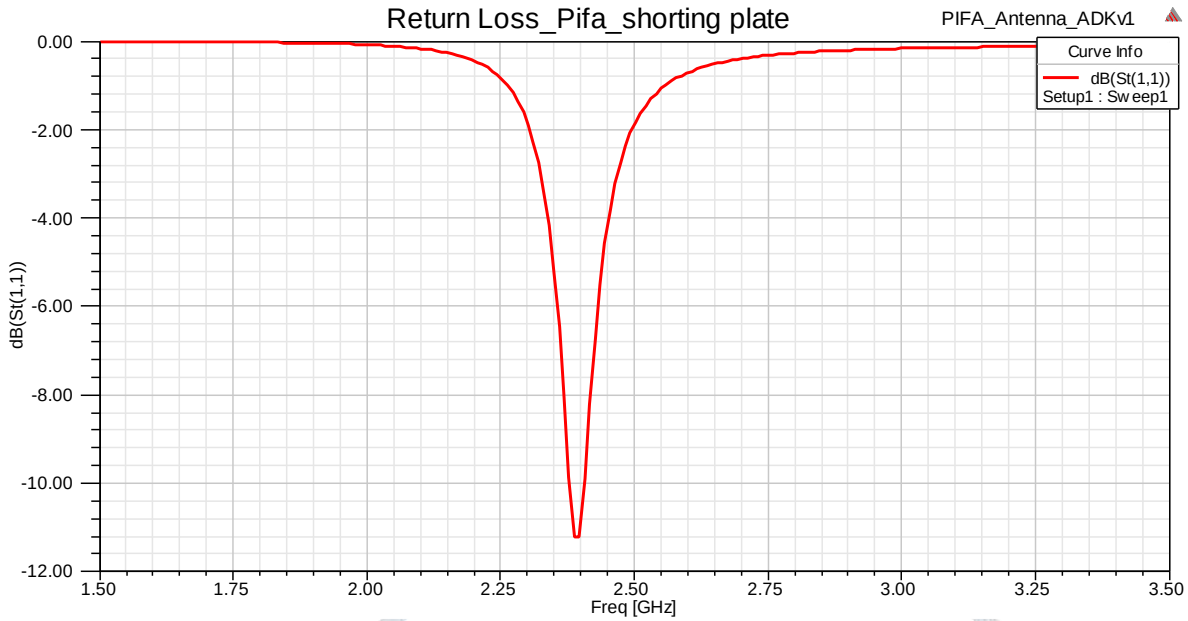

Figure 7: Return loss of the PIFA with the shorting plate.

Figure 8 shows the 2D gain of the PIFA with the shorting plate. It can be inferred from the fig 8 that the gain are around 5 dB.

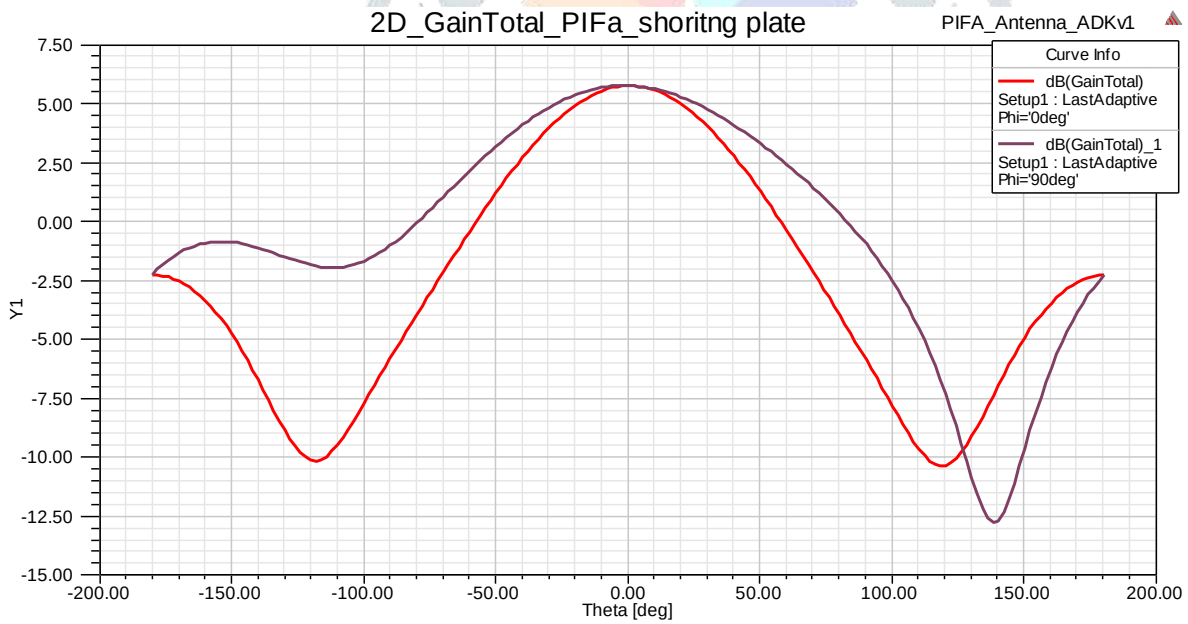

Figure 8: 2D gain of the PIFA with the shorting plate

Conclusion: The author has compared PIFA antenna with shorting pin and plate. It can be seen from the simulations diagrams that the gain of the antennas are 2.51dB, 6.45 dB and 3.87 dB respectively with each having a good impedance matching.

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