Design of PASSIVE UHF-RFID TAG ANTENNA DESIGN FORIMPROVED READ RANGE IN PRODUCT PACKAGING APPLICATION

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Abstract— In this proposed paper, a design of passive UHF -RFID Tag PIF antenna for improved read range in product packing application of 2.45Ghz is designed and developed. In recent years, planar inverted-F antenna stay as one of the most popular antenna used in mobile phone, becauseof its low profile, light weight and simple structure. The PIFA antenna is fed by a coaxial cable through a SMA connector. In this work, the different parameters are changed to observe their effects on the characteristics of PIFA as the resonance frequency, the length of the bandwidth and the radiation pattern. The PIFA element is to cover a wide frequency band from 2.31 GHz to 2.71 GHz; therefore, we can find these applications: Wi-Fi (2.45GHz), Bluetooth (2.4 GHz) and the two Long Term Evolution bands (LTE 2.3GHz, LTE 2.5GHz) includes. An EM simulator is used for the simulation of the proposed antenna.For the simulated PIF antenna of the reflection coefficient is -25 dB VSWR is 1.

KEYWORD-Passive UHF , RFID tag , PIFA , VSWR , S-Parameter

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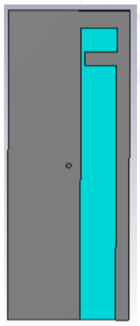
I. Introduction

Microstrip antenna is a class of the low profile antennas used in the wireless communication systems. It has attracted increasing interest in recent years among communication engineers. In the last decade, the quantity of wireless standards increased, because of the miniaturization, novelty and cost reduction. With analog in addition to digital services, wideband technologies also emerged. Figure 1.1 summarizes the operating bands of different wireless communication standards, where it can be observed that the large portion of available RF spectrum is reserved for these systems. Obviously, the addition of many technologies in RF devices will enhance their functionality significantly. The Planar Inverted-F antenna (PIFA) is increasingly used in the mobile phone market. The antenna is resonant at a quarter-wavelength (thus reducing the required space needed on the phone), and also typically has good SAR properties. This antenna resembles an inverted F, which explains the PIFA name. The Planar Inverted-F Antenna is popular because it has a low profile and an omnidirectional pattern. The PIFA is resonant at a quarter-wavelength due to the shorting pin at the end. We'll see how the resonant length is defined exactly in a minute. The feed is placed between the open and shorted end, and the position controls the input impedance. The Samsung Galaxy S is an android smartphone that works on CDMA networks in the US. This means the frequency will be 850 and 1900 MHz, requiring one transmit/receive antenna and one receive-only antenna (known as a diversity antenna).The Planar Inverted-F antenna (PIFA) is increasingly used in the mobile phone market. The antenna is resonant at a quarter-wavelength (thus reducing the required space needed on the phone), and also typically has good SAR properties. This antenna resembles an inverted F, which explains the PIFA name. The Planar Inverted-F Antenna is popular because it has a low profile and an omnidirectional pattern. The PIFA is shown from a side view in Figure 1.5.The PIFA is resonant at a quarter-wavelength due to the shorting pin at the end. We'll see how the resonant length is defined exactly in a minute. The feed is placed between the open and shorted end, and the position controls the input impedance. The Samsung Galaxy S is an android smartphone that works on CDMA networks in the US. This means the frequency will be 850 and 1900 MHz, requiring one transmit/receive antenna and one receive-only antenna (known as a diversity antenna).

II. Proposed System



For the conventional PIFA antennas, each PIFA-patch element will be designed carefully based on approximately equation . This equation is a very rough approximation which does not cover all the parameters which significantly affect the resonance frequency of PIFA

Fr=c4(Lp+Wp)√εr

fr is the resonance frequency at desired band.
Lp is the length of the radiating element.
Wp is the width of the radiating element.
sr is the dielectric constant of the substrate.
c is the speed of light.

The configuration of the PIFA is shown in Figure 4. The radiating plate has the dimensions of Wp×Lp (Figure 2) and ground plane dimensions are Wg×Lg. There is an FR-4 substrate (hs=1.6mm) has a relative dielectric constant of 4.4 and it is between the rectangular ground plane and radiating plate. The antenna height is h=ha+hs and the space between the top plate and the substrate are also filled with air (free space). In practice, a substrate is generally just underneath the top plate, but this will make the top plate too heavy to be supported by the shorting and feeding plates. The shorting plate with the dimensions of Wsh×h is placed under the top corner of the top plate. The horizontal distance between shorting and feed plates is x. The distance between the coaxial cable and the right edge of the ground plane is Wp/2 and even for shorting plate. The PIFA antenna is fed by a coaxial cable through a subminiature version A (SMA) connector. The software package used for simulation is CST Microwave Studio v.11 and High Frequency Structure Simulator (CST).

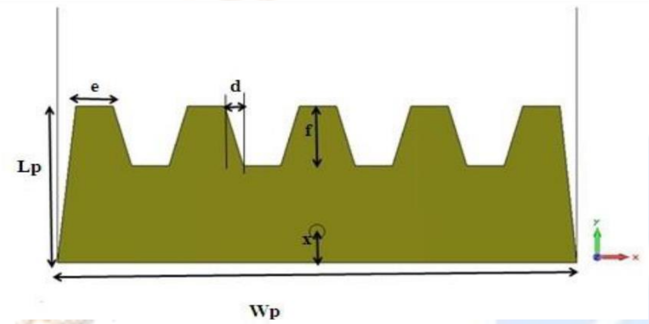


Figure 4

Figure4 We changes the position of the feed pin by modifying the values of the horizontal distance x from 1.5 to 3.6 mm, the length of the radiating plate Lp from 8 to 20 mm, the width of the radiating plate Wp from 24 to 50 mm and height between substrate and the radiating plate ha from 3 to 10mm. we can observe this effects on PIFA characteristics while other parameters are constant.

III.DATA FLOW DIAGRAM FOR PROPOSED SYSTEM:

The Planar Inverted-F antenna (PIFA) is shown in figure 5, is increasingly used in the mobile phone market. The antenna is resonant at a quarter-wavelength (thus reducing the required space needed on the phone), and also typically has good SAR properties. This antenna resembles an inverted F, which explains the PIFA name. The Planar Inverted-F Antenna is popular because it has a low profile and an omnidirectional pattern. The PIFA is shown from a side view .

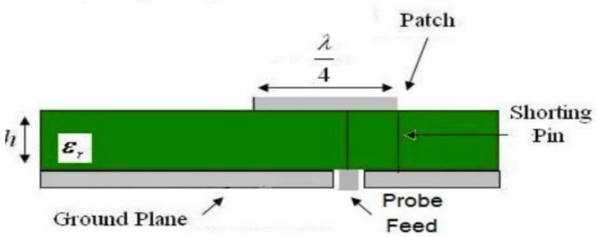


Figure 5

The PIFA is resonant at a quarter-wavelength due to the shorting pin at the end. We'll see how the resonant length is defined exactly in a minute. The feed is placed between the open and shorted end, and the position controls the input impedance. The Samsung Galaxy S is an android smartphone that works on CDMA networks in the US. This means the frequency will be 850 and 1900 MHz, requiring one transmit/receive antenna and one receive-only antenna (known as a diversity antenna).

IV. RESULT AND DISCUSSION

After going through all the parametric studies and finalizing the design parameters for each antenna, the verification of the final design takes place using CST software.S- parameters describe the input-output relationship between ports (or terminals) in an electrical system. For instance, if we have 2 ports (intelligently called Port 1 and Port 2), then S12 represents the power transferred from Port 2 to Port 1. S21 represents the power transferred from Port 1 to Port 2. In general, SNM represents the power transferred from Port M to Port N in a multi-port network. A port can be loosely defined as any place where we can deliver voltage and current. So, if we have a communication system with two radios (radio 1 and radio 2), then the radio terminals (which deliver power to the two antennas) would be the two ports. S11 then would be the reflected power radio1 is trying to deliver to antenna 1. S22 would be the reflected power radio 2 is attempting to deliver to antenna 2. And S12 is the power from radio 2 that is delivered through antenna 1 to radio 1. Note that in general S-parameters are a function of frequency (i.e. vary with frequency).

ITERATION-1 :

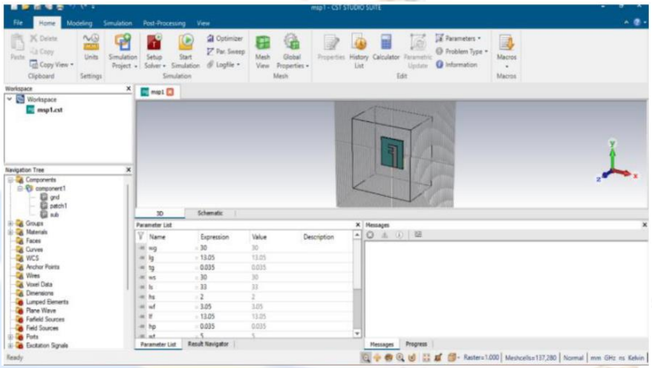


Figure 6

From the fig 6,We observed that this the 3D model of Iteration 1 Inverted F Antenna.

S PARAMETER :

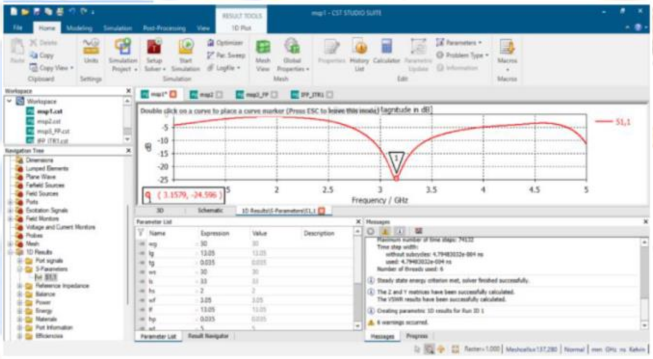
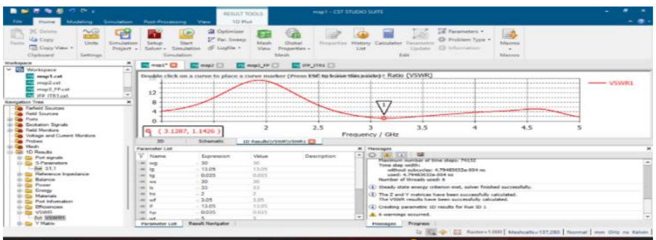


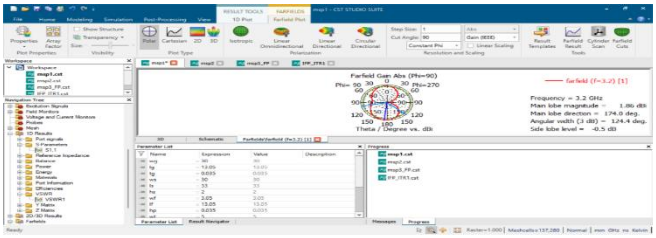
Figure 7

From the fig 7,The value S parameter is 3.1579.
The Return loss is -24.596.

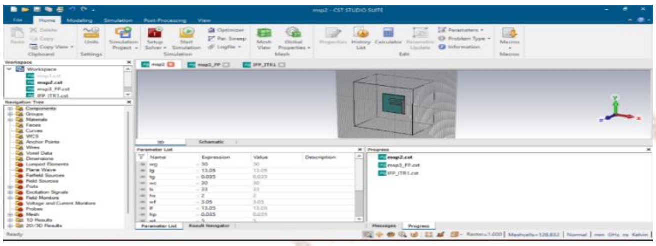
VOLTAGE STANDING WAVE RATIO :



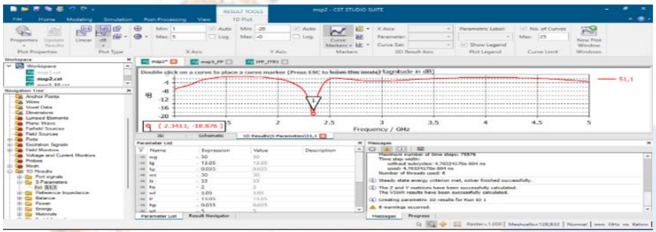
FARFIELD :



ITERATION-2 :



S PARAMETER :



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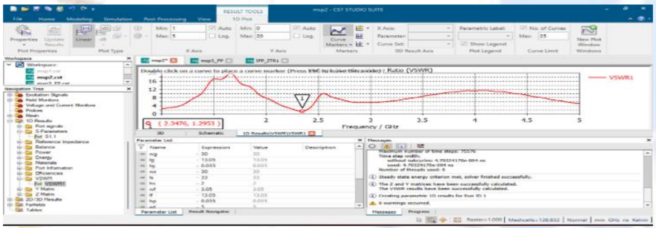
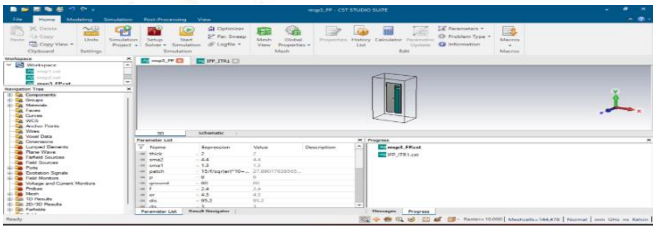
VOLTAGE STANDING WAVE RATIO :

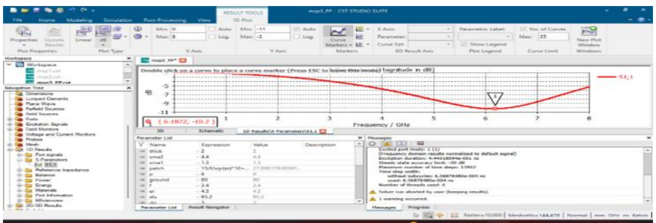


FARFIELD :

ITERATION-3 :



S PARAMETER :



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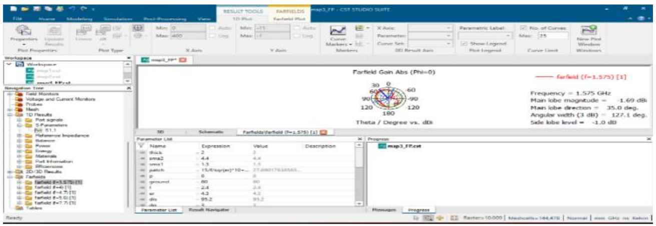
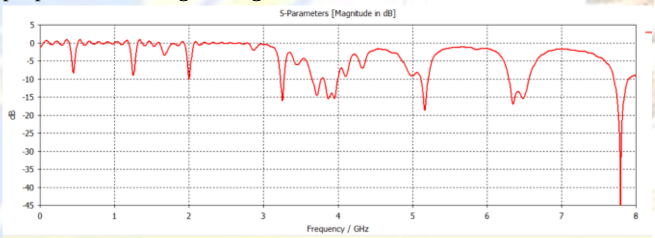
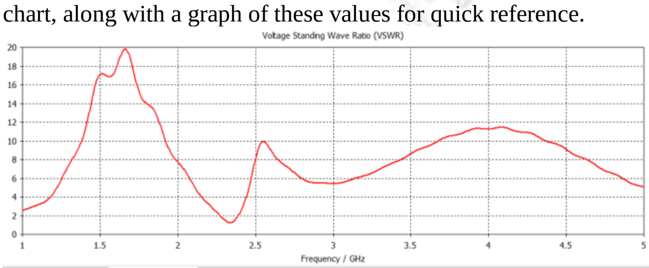


V TESTING AND SUPPORT

After going through all the parametric studies and finalizing the design parameters for each antenna, the verification of the final design takes place using CST software. FIGURE 4-1 shows the return loss versus frequency simulation for the microstrip LED antenna using CST.S-parameters describe the input-output relationship between ports (or terminals) in an electrical system. For instance, if we have 2 ports (intelligently called Port 1 and Port 2), then S12 represents the power transferred from Port 2 to Port 1. S21 represents the power transferred from Port 1 to Port 2. In general, SNM represents the power transferred from Port M to Port N in a multi-port network. A port can be loosely defined as any place where we can deliver voltage and current. So, if we have a communication system with two radios (radio 1 and radio 2), then the radio terminals (which deliver power to the two antennas) would be the two ports S11 then would be the reflected power radio 1 is trying to deliver to antenna 1. S22 would be the reflected power radio 2 is attempting to deliver to antenna 2. And S12 is the power from radio 2 that is delivered through antenna 1 to radio 1. Note that in general S-parameters are a function of frequency .(i.e. vary with frequency).The figure 4-1 shows that there is a difference between the result of the software simulation for three modes,but this difference is within the acceptable range.The figure shows that the proposed antenna gives a good return loss at 5-5.6Ghz.



The Voltage Standing Wave Ratio (VSWR) is an indication of the amount of mismatch between an antenna and the feed line connecting to it. This is also known as the Standing Wave Ratio (SWR). The range of values for VSWR is from 1 to ∞ . A VSWR value under 2 is considered suitable for most antenna applications. The antenna can be described as having a "Good Match". So when someone says that the antenna is poorly matched, very often it means that the VSWR value exceeds 2 for a frequency of interest. Return loss is another specification of interest and is covered in more detail in the Antenna Theory section. A commonly required conversion is between return loss and VSWR, and some values are tabulated in chart, along with a graph of these values for quick reference.



VI CONCLUSION

The new design PIFA proposed in this article can cover the frequency range from 2.31 GHz to 2.71 GHz (400 MHz), therefore, it includes applications: Wi-Fi (2.4GHz), Bluetooth (2.4 GHz) and the two LTE bands (2.3GHz, 2.5GHz). The Changes of the length of the top radiating plate (Lp), the width of the top radiating plate, the height between the top radiating plate and the substrate (ha) and the feed position (x) changes the frequency of resonance and bandwidth and don't have significant effect on the radiation pattern.

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