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New GSM, DCS and GSM/DCS Pifa Antennas Designs for Wireless Networks Applications

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ABSTRACT

The work presented in this paper is focused on the analysis, design and characterization of single and multi band PIFA antennas operating in GSM, DCS and GSM/DCS for wireless networks applications. We propose a new design of PIFA antenna structure for use in mobile phones with small size and capable to support multiple communications standards. Parametric studies have allowed us to establish the influence of the metallic pin on the operation of PIFA antenna which will facilitate the design of this type of antenna. Various encouraging results are obtained in matching and radiation. the synthetized antennas can be employed for GSM, DCS and GSM/DCS for wireless networks applications.

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1. INTRODUCTION

The phones are increasingly indispensable in our daily life. Today are not simple voice communication devices. Their features become numerous. For the antenna, many covered bands are operational due to the evolution of communication standard [1-5]. In a communication system, the antennas are integral components requiring specific consideration while seeking to improve the performance of an antenna; we must adapt it to the latest applications. We are witnessing a phenomenon of miniaturization of systems which also affect the automotive sector; the growth response to various standards such as GSM, DCS, and new antennas should be able to cover most of the bands corresponding to these services. The market for mobile telephony has grown considerably, with a trend to reduce significantly the size and weight of the device. This remarkable reduction has led to a rapid development of antennas for these phones. Designing antennas for mobile phones, the following characteristics should always be taken into count: compact structure, light weight, durability and low cost. A few years ago, most of the antennas used for mobile phones were monopole. With the development of new standards and design constraints, phone manufacturers now prefer integrated antennas. Thus, those that best meet this new requirement are PIFA antenna type [6-10].

The decrease in the size of the antenna and improved link performance then become critical issues. Miniaturization of devices that provides these applications are very beneficial to the need to reduce the size of existing antennas. The needs of these services continue to increase imposed an implementation of multiple functions on a single multi-band where the notion of the antenna device.

The goal of this paper devoted to the single-band and multi-band FIFA antennas operating in several bands.

2. SINGLE-BAND PIFA ANTENNAS DESIGN

The geometry of the proposed PIFA antenna is displayed in the figure 1. The antenna is composed of metallic ground plane and a sesonator. A short circuit is employed to connect the resonator to the ground plane.

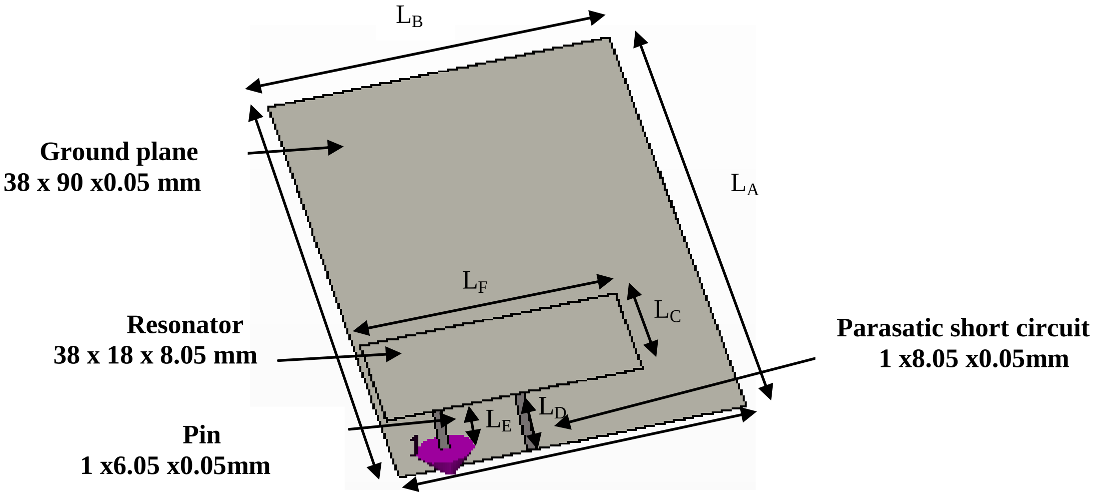


Figure 1. The proposed single band PIFA antenna geometry.

2.1. Single PIFA Antenna operating in the frequency 900 MHz for GSM applications

The first proposed antenna is simulated using CST microwave studio and the obtaind return loss in the frequency range [0-2.5 GHz] is depected on the Figure 2.

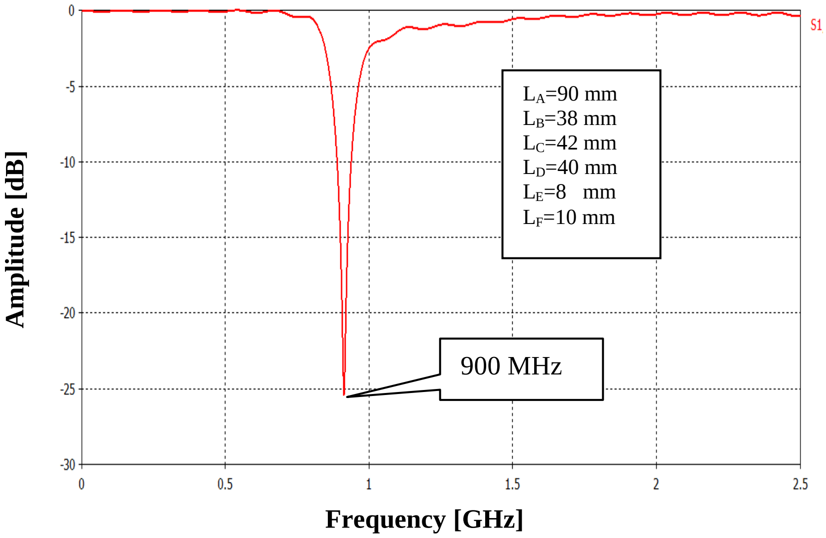
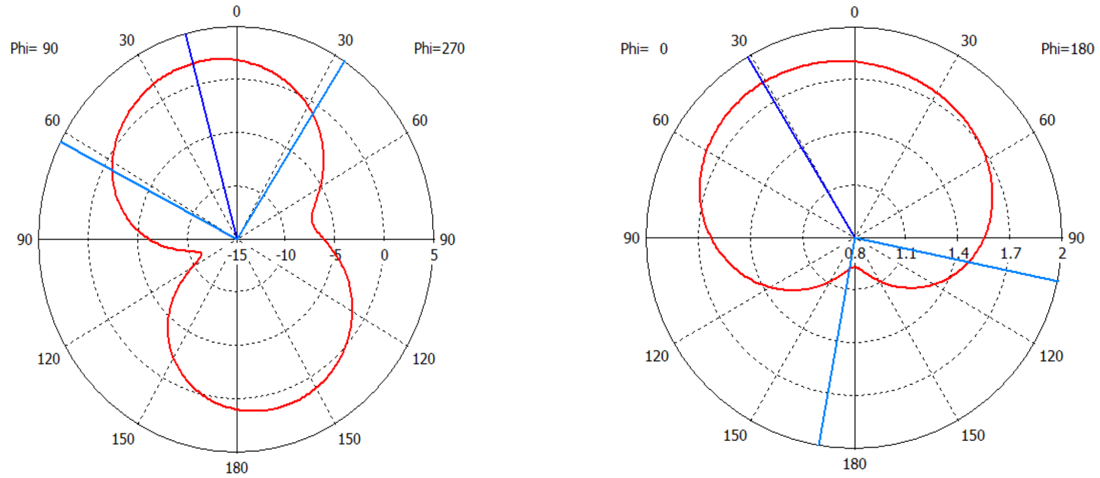


Figure 2. Single band GSM PIFA Antenna computed return loss.

Let us notice from figure 2, displaying the results of the single band GSM PIFA antenna computed return loss a mono-band character. The antenna used gives an excellent matching at the resonant frequency and the recorded minimum of reflection is of about -26 dB.

The radiation patterns in polar coordinates computed at the frequency 900 MHz distinated for GSM applications in E-plane and H-plane are presented in figure 3.



(a) (b)

Figure 3. Radiation pattern in polar coordinate computed at the frequency 900 MHz.
(a) E-plane phi=90°, (b) H-plane phi=0°.

2.2. Single PIFA Antenna operating in the frequency 1800 MHz for DCS applications

Let us now simulate another PIFA antenna operating in 1800 MHz for DCS applications. The CST software obtained results are presented in Figure 4 in the frequency range [0-2.5 GHz]. The antennas dimensions are reported in table in figure 4.

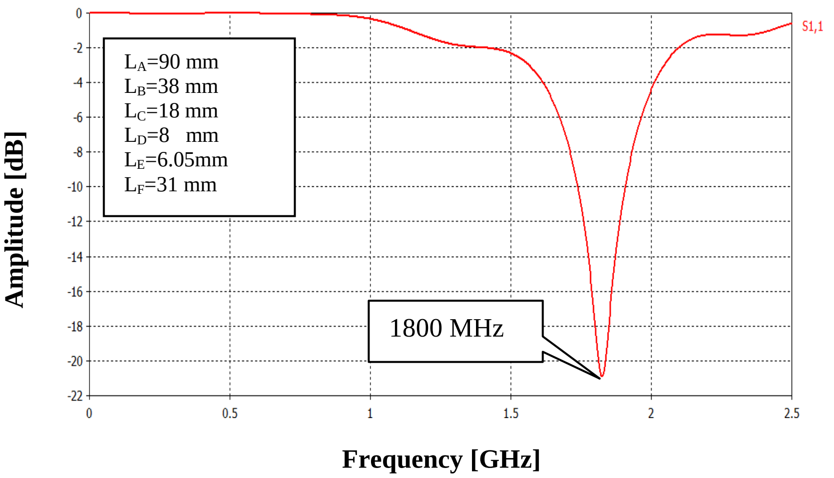
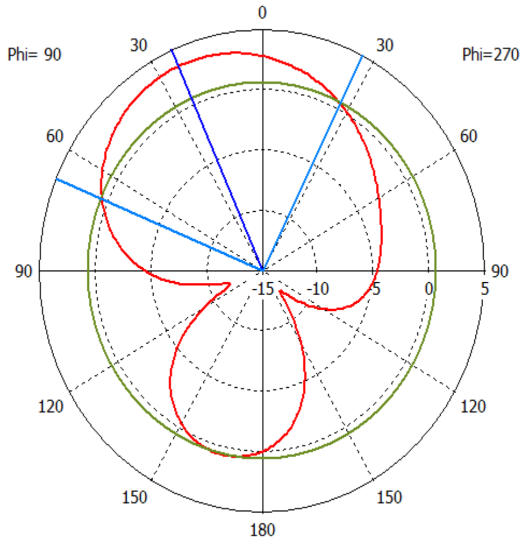


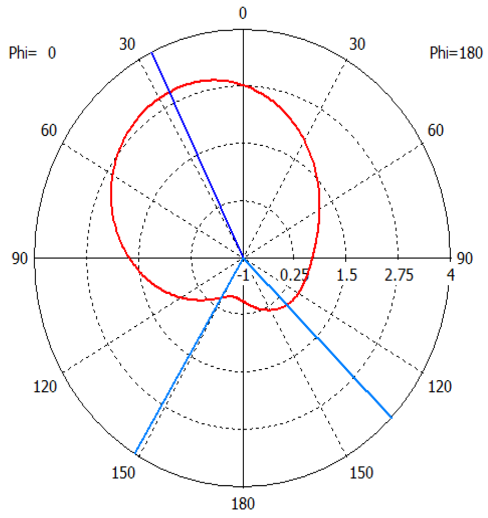
Figure 4. Single band DCS PIFA Antenna computed return loss.

The return losse presented in figure 4 show an amplitude less than -21 dB at the resonance frequency in the range [0-2.5 GHz], which means that this antenna have a perfect matching and the DCS band is well covered.

The radiation patterns in polar coordinates computed at the frequency 1800 MHz distinated for DCS applications in E-plane and H-plane are presented in figure 5.



(a)



(b)

Figure 5. Radiation pattern in polar coordinates computed at the frequency 1800 MHz.
(a) E-plane phi=90°, (b) H-plane phi=0°.

3. BI-BAND PIFA ANTENNA GSM/DCS

In the figure bellow we present the geometry of the proposed optimized bi-band PIFA antenna matched at GSM/DCS frequencies. The antenna is composed of two metallic sesonators allowing a bi-resonance. A short pin is employed to connect the resonator to the ground plane.

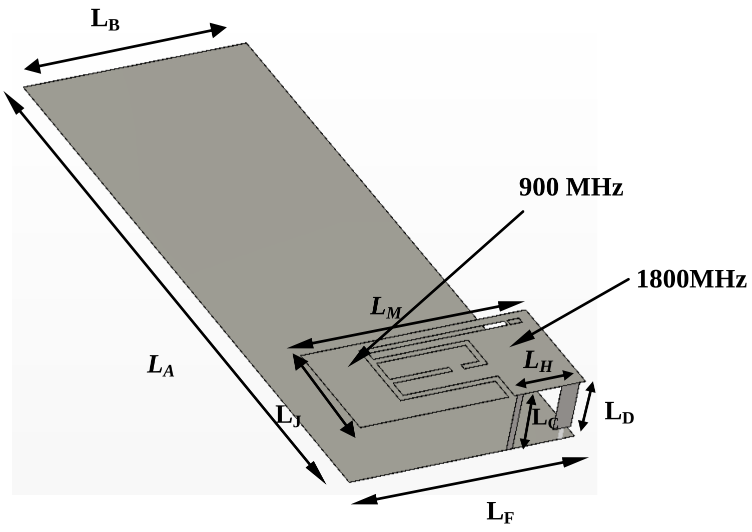


Figure 6. The proposed optimized bi-band PIFA antenna geometry operating in both GSM/DCS.

Meanwhile, in Figure 7 we provide the simulated input antenna return loss. The antennas dimensions are reported in table in figure 7.

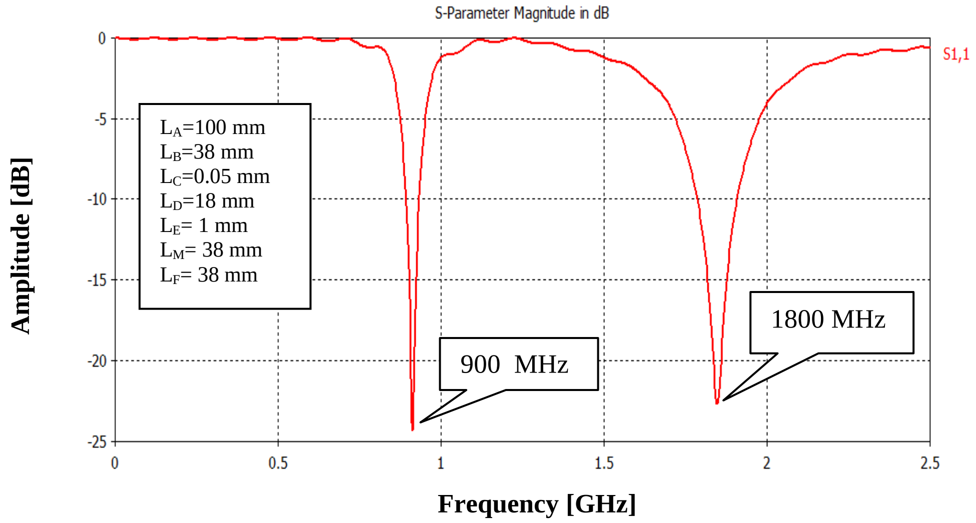
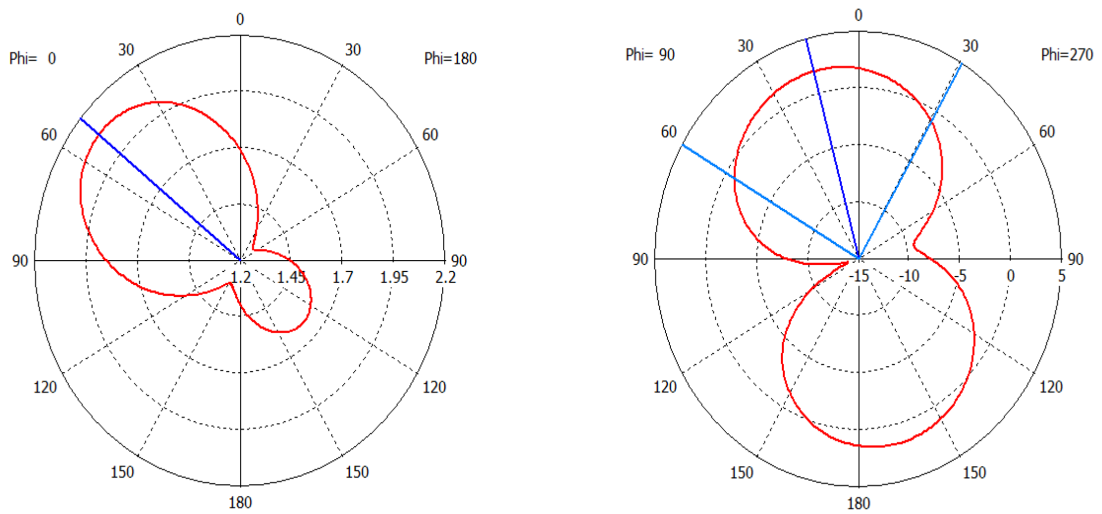


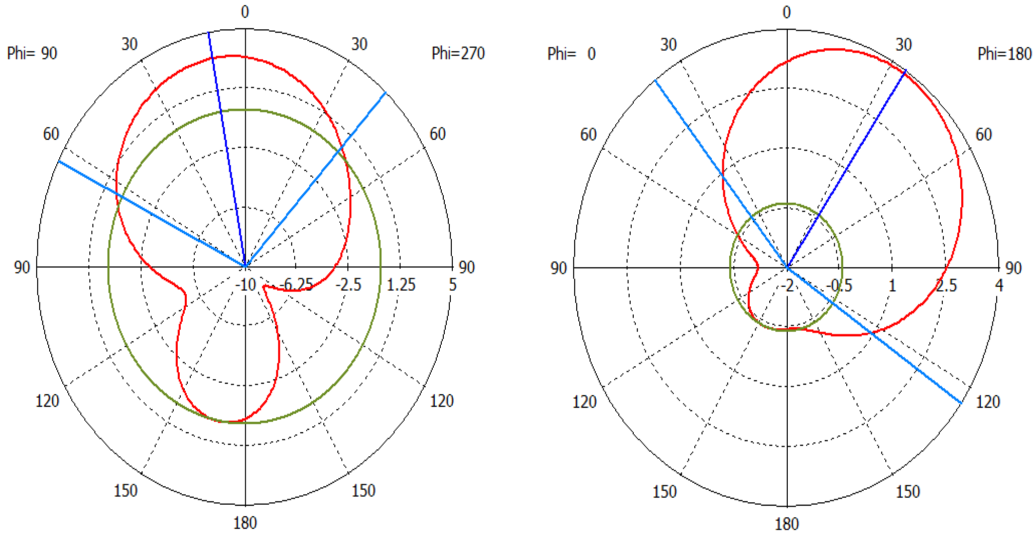
Figure 7. Bi-band GSM/DCS PIFA antenna computed return loss.

Let us notice from figure 7 that a good matching at the input PIFA antenna is obtained at the both frequencies 900 MHz and 1800 MHz and are well predicted. The recorded pics are of about 24 dB and 23 dB. In figure 8 and 9, we displaye the radiation patterns in polar coordinates computed at the frequencies 900 MHz and 1800 MHz distinated for GSM/DCS applications in E-plane and H-plane respectively.



(a) (b)

Figure 8. Radiation pattern in polar coordinates computed at the frequency 900 MHz.
(a) E-plane phi=90°, (b) H-plane phi=0°.



(a) (b)

Figure 9. Radiation pattern in polar coordinates computed at the frequency 1800 MHz.
(a) E-plane phi=90°, (b) H-plane phi=0°.

3. CONCLUSION

In this paper we are interested in the presentation and design of pifa antennas witch are a specific type of miniature antenna for GSM and DCS standards operating in the 900 MHz and 1800 MHz respectively. The simulations were completed using a very powerful tool available in the laboratory of telecommunications, it is CST Microwave Studio. The study of the length of the pin on adaptation was made. Good performance in terms of adaptation and radiation were performed. The developed antennas GSM, DCS and GSM/DCS can be employed for wireless networks applications.

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