INTEGRATED INTERNAL PIFA FOR UMTS OPERATION OF CLAMSHELL MOBILE PHONES

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ABSTRACT: *A novel design of an internal PIFA integrated with an RF-shielding metal case for application in a clamshell or folder-type mobile phone is presented. The integrated PIFA has a bent and tapered radiating arm in order to easily fit in the casing of the clamshell mobile phone as an internal antenna. The integrated PIFA can also provide a wide operating bandwidth for UMTS (1920–2170 MHz) operation. In addition, for the clamshell mobile phone in either the talk or standby condition, only a small effect on the operating bandwidth of the integrated PIFA is obtained. The experimental results of the proposed design are presented.* Microwave Opt Technol Lett 46: 546–548, 2005; Published online in Wiley InterScience (www.interscience.wiley.com). DOI 10.1002/mop.21045

Key words: *antennas; mobile-phone antennas; planar inverted-F antennas (PIFAs); UMTS antennas*

1. INTRODUCTION

Planar inverted-F antennas (PIFAs) are attractive for internal mobile-phone antenna applications, and a variety of related designs have been demonstrated [1]. These designs, however, are mainly for applications in bar-type mobile phones. For folder-type or clamshell mobile phones, which are usually equipped with a large display and are becoming very attractive for wireless users, relatively very few internal PIFA designs have been reported in the open literature [2–5]. The reported internal PIFA designs are mainly studied in the standalone condition. The effects of the nearby associated elements such as the RF-shielding metal case on

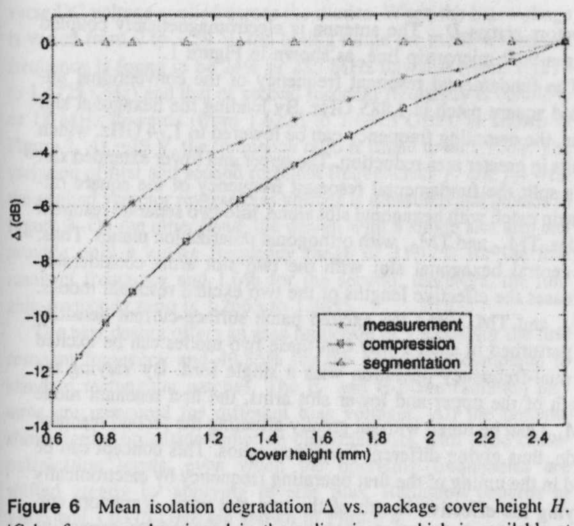

Figure 6 Mean isolation degradation Δ vs. package cover height *H*. [Color figure can be viewed in the online issue, which is available at www.interscience.wiley.com]

dispersion is about 15 dB over the frequency band for both the compression and the measurements.

The segmentation provides poorer results for the double-LNA module's isolation [Fig. 5(d)] than for the single-LNA module. No package-cover effects are predicted by the segmentation results. Our compression approach shows its advantages over the segmentation; a particulary significant advantage involves the isolation parameter of the double-LNA module because the isolation degradation due to the package-cover height's diminution is the most remarkable.

Moreover, the compression shows its capabilities of providing a good prediction of the package-cover height's influence. In order to measure it, a mean degradation Δ_{dB} is defined as follows:

$$\Delta_{dB} = \frac{1}{N} \sum_{n=1}^{n=N} (S_{12}(f_n, H_{max})_{dB} - S_{12}(f_n, H)_{dB}), \qquad (1)$$

where N is the number of frequency points, $f_1 = 2$ GHz and $f_N = 20$ GHz. This parameter is plotted in Figure 6.

The segmentation does not predict any isolation degradation, whereas the isolation degradation foreseen by the compression approach is close to the measured one.

5. CONCLUSION

In this work, it has been shown that the isolation parameter of packaged MMIC LNAs is highly influenced by the package-cover height. The presented study has demonstrated that the compression approach is a suitable tool to predict the degradation of the isolation parameter due to a constraining EM environment. The benefits of the compression approach over the segmentation strategy have been shown. As the compression approach is also suitable to predict the effects of microwave transitions and interconnections [2], this method seems to be a reliable tool to predict all types of packaging effects.

REFERENCES

1. J.-M. Lesage, R. Loison, R. Gillard, T. Barbier, and Y. Mancuso, A simple implementation of the compression approach for the global EM analysis of microwave circuits, Special Issue Int J RF and Microwave

CAE: Bridging between Microwave Eng and Info Technologies 14 (2004), 525–534.
2. J.-M. Lesage, R. Loison, R. Gillard, T. Barbier, and Y. Mancuso, Dispersion analysis of packaged MMIC amplifiers using the compression approach, 34th Euro Microwave Conf, Amsterdam, 2004, pp. 649–652.
3. J. Kunisch, M. Rittweger, S. Heinen, and I. Wolff, The compression approach: A new technique for the analysis of distributed circuits containing nonlinear elements, 21st Euro Microwave Conf, Stuttgart, 1991, pp. 1296–1301.
4. J. Kunisch, A. Bahr, M. Rittweger, and I. Wolff, Analysis of nonlinear circuits using the compression approach, IEEE MTT-S Int Microwave Symp, Philadelphia, PA, 1993, pp. 637–640.
5. Ansoft HFSS, ver. 8.5, Ansoft Corporation, 2002.
6. Advanced Design System, Agilent Technology, 2002.