A Novel Bandwidth Enhancement Approach of the Fully Integrated Transmitter Front-End With High Power-Added Efficiency

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Abstract

A novel approach to enhance PAE and transmitting power bandwidths of the fully integrated transmitter front-end is proposed. To obtain these characteristics, a wideband multi-functional antenna operating as a wideband output matching load of the power amplifier and wideband harmonic tuning circuits as well as a radiator is presented and experimentally demonstrated. Therefore, the wideband direct integration between the output of the power amplifier and input of the antenna can be achieved without any wideband impedance transformers. Under the condition of PAE over 50% and transmitting power within 3 dB for the peak transmitting power at the operating band, the measured PAE and transmitting power bandwidths are 930 MHz (from 4.9 to 5.83 GHz) and 1030 MHz (from 4.8 to 5.83 GHz), respectively. Also, about a half size is obtained compared with the conventional wideband active antenna for high PAE, and the second and third harmonic radiations of the proposed wideband transmitter front-end for the normalized peak power of the fundamental frequency are measured less than -30 and -40 dB in all directions, respectively.

I. INTRODUCTION

The power added efficiency (PAE) of the power amplifier has been always considered as a very important theme in wireless communication systems because it has a direct influence on power consumption (especially, the battery life in the mobile environment) and leads to compact and portable RF products. Furthermore, as the trend of modern advanced wireless communication systems moves toward the low power consumption and long term operating conditions, the importance of PAE increases more and more. To maximize its PAE, many approaches on the power amplifier itself have been carried out in the past [1-4]. Since these power amplifiers with high PAE are discretely connected with antenna as shown in Fig. 1(a), these structures cause large size, complex structure, and difficulty of design for compact RF front-ends.

To overcome these disadvantages, the active integrated antenna (AIA) shown in Fig. 1(b) was recently proposed [5-8]. In the AIA structure, the antenna operates as both a radiator and a tuning network to tune reactively the harmonics at the output of the amplifier. However, in this structure, the additional output matching network of the power amplifier is always needed for impedance matching with antenna, which causes large size, insertion loss, and low PAE for the AIA system. In recent study [9-10], as shown in Fig. 1(c), the fully integrated transmitter front-end with high PAE using the direct impedance matching technique between the power amplifier and antenna, and the modified harmonic suppressed antenna (HSA) was presented. Therefore, the full integration between the power amplifier and antenna is achieved.

In this paper, a novel approach to enhance PAE and transmitting power bandwidths of the fully integrated transmitter front-end [9] using the wideband direct integration between the power amplifier and antenna is proposed, and its configuration is shown in Fig. 1(d). Here, the antenna operates as a wideband output matching load of the power amplifier for wideband PAE and transmitting power and a wideband harmonic tuning circuit as well as a wideband radiator. Therefore, the wideband direct integration between the output of the power amplifier and input of the antenna can

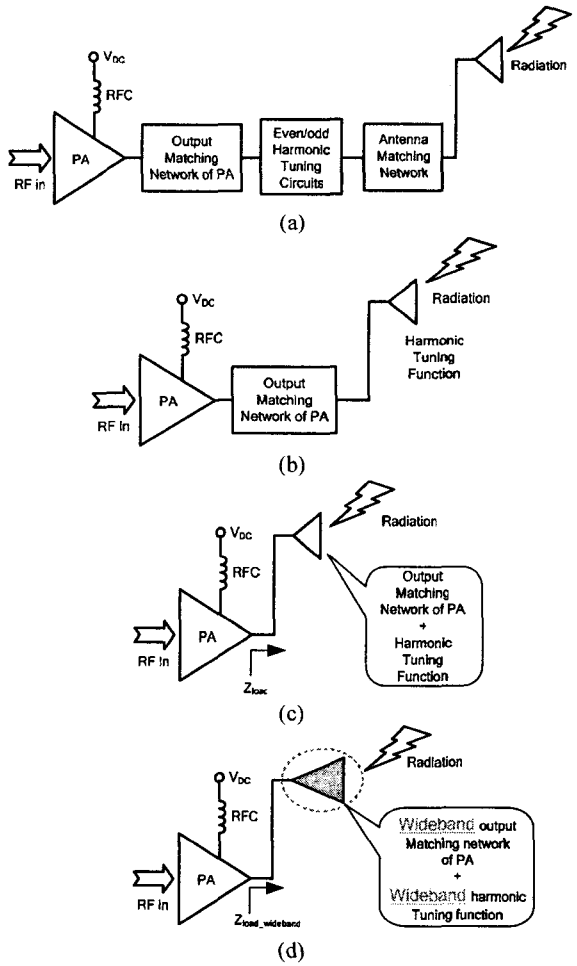

Fig. 1. Configurations of: (a) conventional active antenna for high PAE, (b) active integrated antenna, (c) fully integrated transmitter front-end with high PAE (d) the proposed wideband fully integrated transmitter front-end for PAE and transmitting power bandwidth enhancement.