A NEW METHOD TO OBTAIN A WAVEFORM FOR THE ENVELOPE MODULATOR: SUPPLY-MODULATED RF POWER AMPLIFIER WITH REDUCED BANDWIDTH POWER SUPPLY WAVEFORM

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BACKGROUND

Envelope tracking has become pervasive. It is used in most smart phones today for 4G (LTE) signals. With the advent of 5G, there is a new crop of base stations needed for sub-6GHz operation that are required to perform with high efficiency over multiple carrier frequencies, and there are research reports of people using envelope tracking to achieve this goal. UC San Diego's patented supply-modulated RF power ampmplifier technology refers to a method to obtain a waveform for the envelope modulator that is not the same as the signal envelope, but has a reduced bandwidth, and easier to generate efficiently. It is thought that almost every system that uses envelope tracking uses a signal to the envelope modulator that has lower bandwidth than the true envelope.

TECHNOLOGY DESCRIPTION

Engineers at UC San Diego have patented a supply-modulated RF power amplifier architecture in which the bandwidth of the dynamic power supply waveform is reduced. Specifically, this invention is a method of generating a reduced bandwidth envelope signal $V_{DD}(t)$ for the power supply modulator of an RF amplifier. An envelope signal of an RF amplifier input $V_{env}(t)$ is low pass filtered. The filtered envelope signal is subtracted from the envelope signal to obtain a difference signal, which is rectified to produce a residue signal. The residue signal is low pass filtered and added back into the filtered envelope signal. An iterative process of the rectifying, low pass filtering the residue signal adding it back is continued until a condition of $V_{DD}(t) \geqq V_{env}(t)$ is met.

This invention describes power supply modulated RF amplifiers and amplification methods utilizing power supply waveforms that are slowly varying, reduced bandwidth signals, but provide high overall power amplifier efficiency. High efficiency is maintained because the reduced bandwidth power supply waveform improves the efficiency of the supply modulator even though it degrades the efficiency of the RF stage. Distortion caused by the bandwidth reduction in the power supply waveform can be compensated by adaptive pre-distortion of the RF input signal. The choice of power supply waveform is constrained by two conditions: 1) the voltage must be sufficiently large to not cause clipping of the amplifier output; and 2) it must be delivered with sufficient accuracy such that the error it introduces can be compensated by adjustment of the RF input signal.

APPLICATIONS

Example applications include wideband wireless communications, networks and wireless wide area network equipment, e.g., cellular network base stations. Specific applications include code division multiple access (CDMA, WCDMA) and orthogonal frequency multiple access (OFDM) systems such as WiMAX and LTE.

ADVANTAGES

RF amplification methods and RF amplifiers of this patented invention provide relaxed design requirements of the supply modulator. Methods and amplifiers of the invention can improve the efficiency and linearity of the supply modulator for wideband applications. Methods and amplifiers of the invention can also provide designers with flexible trade-offs between the supply modulator and the RF power amplifier in terms of the efficiency, linearity and bandwidth.

INTELLECTUAL PROPERTY INFO

This technology is patented (US Patent No. 8,159,295) with commercial licensing rights available.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	8,159,295	04/17/2012	2009-322

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OTHER INFORMATION

CATEGORIZED AS

- Communications
  - Networking
  - Wireless

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