A New Supply-Modulated RF Power Amplifier With Reduced Bandwidth Power Supply Waveform

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BACKGROUND

Modern wideband (broadband) wireless communication systems use a broadband link that is established in a spectrally efficient way by employing linear modulation schemes as QPSK, OQPSK, and OFDM. The design of power amplifiers in the RF transmitters is challenging because the goal is to amplify a modulated RF signal with high peak-to-average while using minimum DC power consumption. Class AB amplifiers traditionally used for RF amplification are poorly suited to meet these goals.

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 $V_{envelope}(t)$ for the power supply modulator of an RF amplifier. An envelope signal of an RF amplifier input $V_{analog}(t)$ is low pass filtered. The filtered envelope signal $V_{filtered}(t)$ 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 $V_{envelope}(t) \geq V_{filtered}(t)$ 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.

SUGGESTED USES

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

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