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Monolithic Supply-Modulated RF Power Amplifier and DC-DC Power Converter IC

As a result of inefficiency, radio frequency (RF) power amplifiers typically consume high levels of current. Consequently, there have been numerous attempts to use external circuitry in order to improve the efficiency of RF power amplifiers located on integrated circuits (ICs); however, these attempts have failed to provide the desired improvements in efficiency. Specifically, because internal switching frequencies can be orders of magnitude faster than off-chip signals, external power supplies and control circuits are often unable to respond rapidly enough to varying load conditions. In addition, the parasitic resistance and inductance of the interconnects between the IC and the external circuitry can reduce voltage swing of the power amplifier, increase power loss, and induce resonance and instability.

Electronic devices, mobile electronic devices in particular, can greatly benefit from more efficient RF power amplifiers. Mobile electronic devices, for example, can achieve considerable improvements in battery life by incorporating more efficient RF power amplifiers. This can be particularly relevant when considering other technological improvements are quickly outpacing improvements in battery life technology.

Researchers at Arizona State University have developed an efficiently operating RF power amplifier that is also capable of internal integration. The RF power amplifier uses envelope elimination and restoration to linearize a switched-mode power amplifier. The device employs a synchronous buck DC-DC converter integrated with the switched-mode power amplifier and provides its supply voltage while tracking the envelope of the RF input signal. Integrating the synchronous buck DC-DC converter in proximity with the switched-mode power amplifier can increase voltage swing, decrease power loss, and reduce parasitic inductance and resistance.

Potential Applications

- Mixed-Signal ICs
- Memory Chips
- RF Front-End
- Signal Processors
- Microcontrollers

Benefits and Advantages

- Improves Operating Efficiency of RF Power Amplifiers
- Increases Voltage Swing
- Reduces Parasitic Inductance and Resistance
- Decreases Power Loss

- Provides Internally Integrated RF Power Amplifiers
- Improves Speed ? rapidly responds to varying load conditions
- Reduces Cost ? reduced material requirements