High Voltage, High Efficiency HBTs for 3G and 4G Amplifiers

TriQuint Semiconductor

The search for more efficient power amplifier technologies to address needs of the 3G and 4G base station market is a continuous one. Put simply, the efficiency of a power amplifier can be thought of as the amount of RF power it transmits divided by the amount of DC power it consumes in order to generate the RF signal. The difference between consumed DC and transmitted RF power is left as the waste product enemy of all things electronic—heat. Heat must be removed, so large and heavy heatsinks are used in base station superstructures, cooling fans run continuously and air conditioning systems strain to keep up with the thermal load.

Operators of GSM-based systems were accustomed to the high efficiencies of a saturated power amplifier design, so the 10 percent efficiencies of early 3G power amplifier products were a rude awakening, and they had the electric bills to prove it. In response, base station OEMs have been working to optimize their designs and have turned towards techniques such as digital pre-distortion and advanced circuit topologies to help improve the state-of-the-art in power amplifier efficiency.

Semiconductor device designers have also been hard at work to make advances in realized power efficiencies within power amplifier transistors. This combination of better semiconductor devices and more sophisticated amplifier designs have today produced power amplifiers that are on the order of 30 percent efficient—a lot better than the early days of 3G deployments, but still not where system operators want efficiency to be. For example: one major system operator has set a goal of 50 percent overall amplifier efficiency for its 3G system; now base station OEMs and RF power device providers are scrambling to find ways to meet this challenge. With 4G deployments and their more difficult signal environments looming on the immediate horizon, it is clear that some revolutionary new design techniques and device technologies will be needed to satisfy operator and radio manufacturer expectations.