Researchers Report New Record for Wireless Base Station Power Amplifiers

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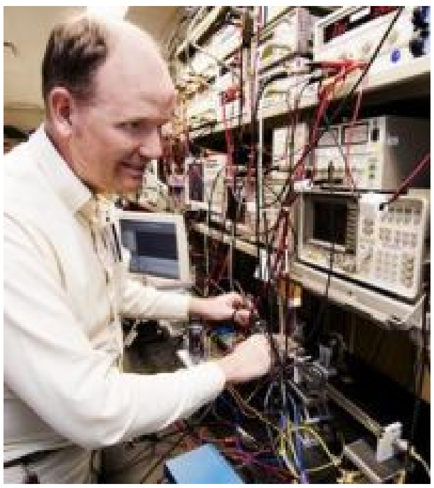

Donald Kimball is the lead author on the study and a principal development engineer at the UCSD Division of Calit2.

(PhysOrg.com) -- When consumers use their cell phones, reception can depend on the strength of the signals coming to and from wireless base stations. Those base stations in turn depend on high-power amplifiers to extend their range – amplifiers that typically consume ten times more power than they generate, for a 10 percent efficiency rate.

Now, three years after breaking the 50 percent efficiency barrier, researchers at the University of California, San Diego report topping an average 58 percent power added efficiency (PAE) – the best rate reported for a single-stage WCDMA base-station power amplifier – with average output power of 42 watts and a gain of 10.2 decibels.

At 58 percent PAE, 50 watts of output power would require only 86 watts of DC power, rather than the 500 watts required by today's high power base stations which operate at 10 percent efficiency.

The recent study also reports the best reported improvement in linearization.

To attain better linearity and the 58 percent PAE on a WCDMA WiMAX base-station power amplifier, the researchers used high-voltage heterojunction bipolar transistors (HVHBTs) based on gallium arsenide (GaAs), rather than silicon-based technology used in most of today's 3G base stations, or the gallium nitride (GaN) metal semiconductor field effect transistor (MESFET) used to demonstrate the record 50 percent average PAE in 2005.

"GaAs HVHBTs are attractive options since they can provide both high voltage and high efficiency and gain over wide dynamic range signals," said lead author Donald Kimball, principal development engineer at Calit2. "Having high efficiency over wide dynamic range is critical because in 3G systems, the demand for power varies widely from instant to instant given the wide variety of modern cell phone communications that go well beyond voice calls."

As with their earlier work, the UC San Diego engineers combined the heterojunction device with a technique known as envelope tracking, which involves variable power signals instead of the constant feed of DC voltage that is common in high-power amplifiers. The technique adjusts voltage dynamically while reducing the heat generated by the transistor and allowing the amplifier to operate closer to saturation.

Two wireless infrastructure manufacturers – Finnish-based Nokia and

China-based HuaWei – have already expressed interest in the UC San Diego findings, which were reported in a paper delivered last week at the 2008 IEEE Compound Semiconductor IC Symposium (CSICS) in Monterey, Calif.

The record was achieved during recent tests in the High-Power Amplifier Laboratory of the UCSD Division of Calit2. The transistor devices were fabricated using TriQuint Semiconductor, Inc.'s GaAs HVHBT process, and three TriQuint engineers co-authored the resulting CSICS paper (Craig Steinbeiser, Thomas Landon and Oleh Krutko).

"TriQuint provided Calit2 with fifteen transistors with a custom on-package match for Envelope Tracking Technology," said Kimball. "They also sent their top engineers to our facility to work with our students on the project."

Kimball's co-authors at UC San Diego included Jacobs School of Engineering electrical and computer engineering (ECE) professors Peter Asbeck and Larry Larson (who is also the chair of the department); as well as ECE graduate students Myoungbo Kwak, Jinho Jeong, Chin Hsia and Paul Draxler (who is also an engineer at QUALCOMM Inc.).

The IEEE Compound Semiconductor IC Symposium (CSICS) is the preeminent international forum on developments in integrated circuits using compound semiconductors.

Provided by University of California, San Diego