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WAMICON "Best Paper" Renews Interest in Parametric Power Amplifiers

"Parametric Power Amplifiers: Old Ideas, New Technologies," by J. Stevenson Kenny of Georgia Tech received the "Best Paper" award this past April at WAMICON 2010. To begin the paper, Dr. Kenney reviewed parametric amplifier ("paramp") design, which was commonly used for low noise microwave amplifiers in the 1950s and 60s. With the development of low noise GaAs FET devices in the 1970s, paramps ceased to be of interest, although they are still used in optical systems.

The present investigation was motivated by several factors. High voltage GaN devices can replace the older silicon varactors, allowing higher output power to be achieved. Also, paramps can theoretically be designed for wide bandwidth. This permits implementation of polar modulation in wireless transmitters, as shown in the conceptual system of Figure 1. As described by Dr. Kenney, "In this architecture, a GaN-based upconverting parametric modulator is driven by a conventional digital baseband/IF subsystem that can incorporate digital predistortion (DPD) to improve transmitter linearity. The IF signal is boosted up to medium power levels using a digitally controlled sigma-delta modulator."

The paper continues by describing wideband design using "degenerate mode" paramps that are a special case, having the pump frequency set to exactly twice the input frequency. Using this design, signals can be separated with directional devices (circulators or couplers) instead of filters, which permits extremely wide bandwidths to be achieved.

The final note of interest is speculation about potential advances in nonlinear inductance, not just capacitance, as with varactors. The right combination of tunable capacitance and inductance would allow the paramp output to track the operating frequency, allowing high efficiency over a much wider bandwidth. A possible structure was presented for such a device, using multiferroic materials.

Notes on Other WAMICON Papers

"An Active, Non-intrusive, High Resolution Microwave Field Probe with Applications in High Power RF Device and Circuit Design," by Steve Cripps of Hywave Associates reported on the author's continuing work on voltage probes that may be used to directly observe the behavior of an operating amplifier, with minimal interaction.

"BSIM4-Based Lateral Diode Model for RF ESD Applications," by Ming-Ta Yang of Qualcomm described a physically based scalable lateral diode model. The accuracy of the diode model was validated with RF characterization data over a broad device geometrical range.

"Novel Rational Fraction Approximations for Passive Network Functions," by Joel Johnson of Harris Corp. The author presented a new approximation method for solving the problem of realizing passive network transfer functions, carried out through the use of passive, reciprocal, lumped, linear, and time-invariant elements.

"A Wide-Band Differential and Single-Ended Microwave Amplitude Detector," by Ming-Che Lee, and William R. Eisenstadt of the University of Florida described a detector circuit that can operate up to 80 GHz, implemented on-chip for test or monitoring of microwave devices.

IEEE Wireless and Microwave Technology Conference (WAMICON) papers are available using the IEEE XPlore service, http://ieeexplore.ieee.org

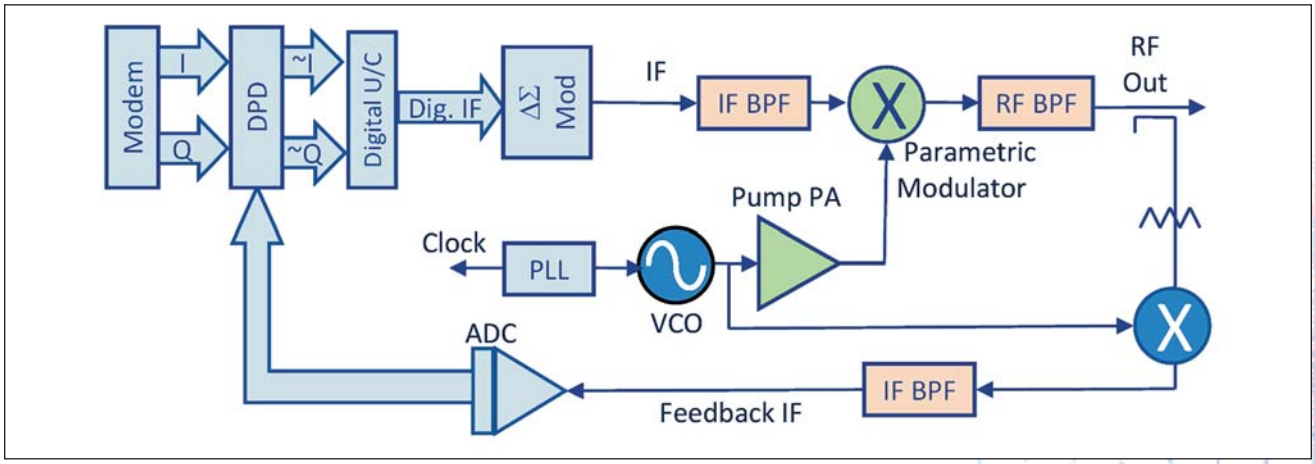

Figure 1 · Polar parametric transmitter architecture (Figure 2 in the referenced paper).