Knowledge Transfer Office
香港城市大學
City University of Hong Kong

High Linearity Doherty Power Amplifier

Communications & Information

Digital Broadcasting, Telecommunication and Optoelectronics

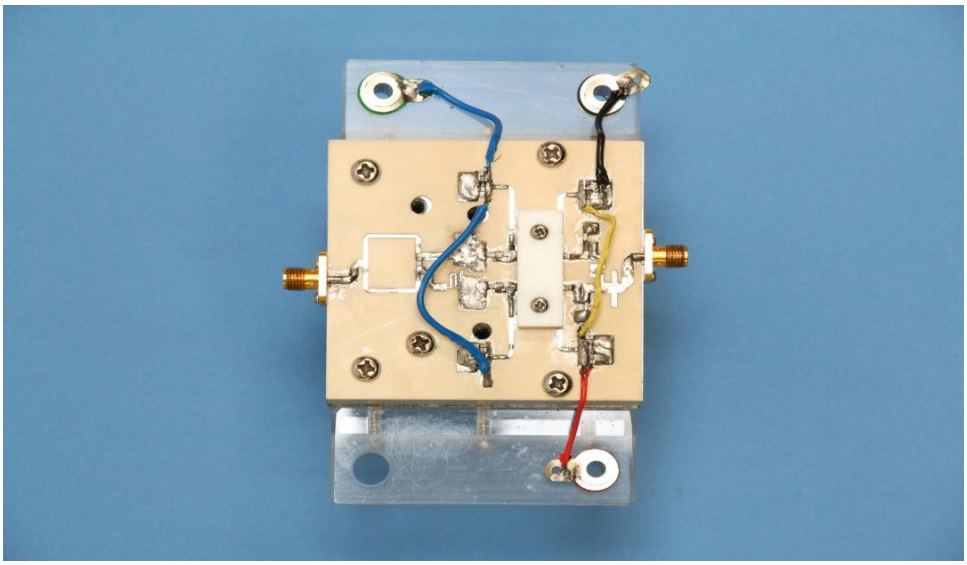

Figure 1: Photo of the fabricated proposed DPA.

IP Status
Patent filed

Technology Readiness Level (TRL) ? 4

Inventor(s)

Prof. CHAN Wing Shing
Dr. ZHOU Xinyu
Dr. CHEN Shichang
Dr. FENG Wenjie

Enquiry: kto@cityu.edu.hk

Opportunity

Doherty Power Amplifiers (DPAs) have been used for maximizing amplification efficiency while maintaining amplifier linearity for signals with high peak-to-average power ratios. In a conventional DPA, harmonic isolation is required between the two transistors to prevent them from modulating each other at harmonic frequencies. Normally at saturation, the current is clipped resulting in poor in-band non-linearity. Hence, mutual harmonic interaction is used to prevent current clipping in the active devices to improve linearity. In this invention, a linearity enhancement technique for Doherty-like power amplifier (DLPA) based on harmonic interaction is presented. The proposed DLPA achieves an excellent trade-off between efficiency and in-band linearity. This will enable the linear amplification of base station power amplifiers in the future wireless communication system like 5G systems.

Technology

The invention comprises two active devices in phase quadrature, a quarter-wavelength phase compensation network (PCN), a high-order lowpass post-matching network (PMN), and two harmonic modulated impedance inverters (HMIIs). In addition, the operating principle of the proposed linear DLPA is able to operate over a relatively wide bandwidth. Reasons being: Firstly, the proposed II (impedance Inverter) has a wider bandwidth of impedance transformation due to the additional electric coupling generated by the coupled line. Secondly, the bandwidth of the second harmonic injection

mainly relies on the phase dispersion of the offset line. Thirdly, for the third harmonic frequency, the two active devices operate independently. Hence, the phase dispersion of the LMN does not influence the third harmonic operating bandwidth. The main idea of the DLPA proposed is the utilization the second and third harmonic components yet not using the additional harmonic injection network (HIN).

Advantages

- The proposed Doherty power amplifier has a wideband operating bandwidth (33%), which can cover the frequency band of 4G and coming 5G.
- It has at least 45% power-added efficiency at 6-dB back-off point.
- It has at least 53% efficiency when the IMD3 firstly reaches -30 dBc.
- The proposed Doherty power amplifier manipulates the second and third harmonic terminations at the same time, which extends the design freedom of Doherty power amplifiers.
- With the help of the proposed harmonic interaction technique, the additional harmonic injection network is avoided. This prevents a loss in bandwidth.

Applications

- To achieve high linearity Doherty power amplifiers (DPAs) in a wide bandwidth. This enables the linear amplification of base station power amplifiers for current and future wireless communication systems.
- This invention can cover most wireless communication frequency bands. For example, the power amplifiers in the base station of 4G wireless communication systems adopt modulated signals with 6.5 dB PAPR. The proposed Doherty power amplifier can provide 45% power added efficiency at 6-dB back-off covering the 33% bandwidth (1.75 GHz - 2.45 GHz).