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Bandwidth Extended Doherty Amplifier

Communications & Information

Digital Broadcasting, Telecommunication and Optoelectronics

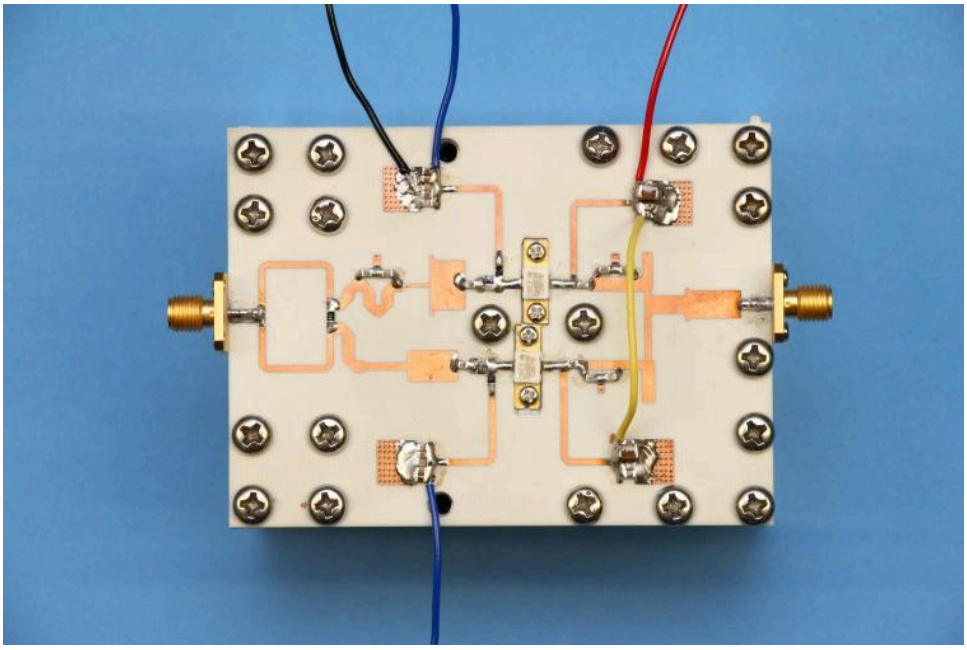

Fig.1 Photo of the fabricated proposed DPA.

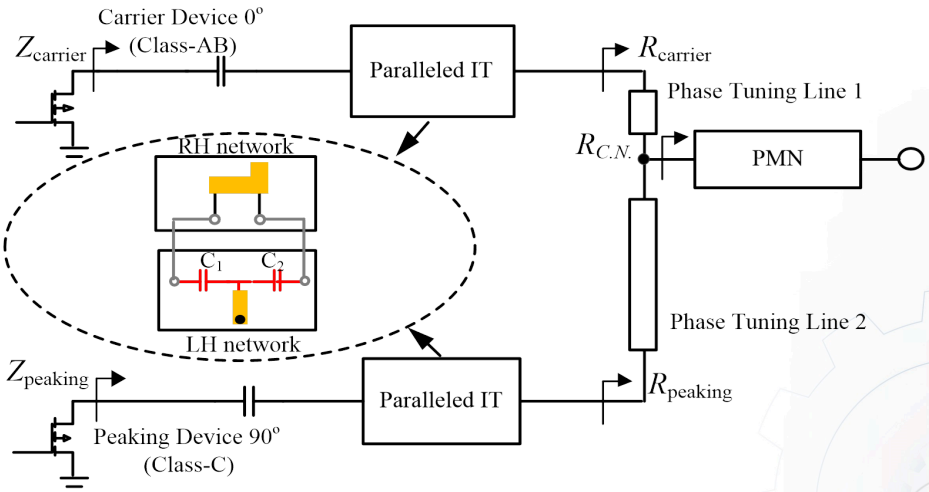

Fig. 2: Structure of the proposed DLPA.

IP Status
Patent granted

Technology Readiness Level (TRL) ? 4

Inventor(s)

Prof. CHAN Wing Shing

Dr. ZHOU Xinyu

Enquiry: kto@cityu.edu.hk

Opportunity

Since the invention of the Doherty amplifier, it has been used as an ideal candidate for maximizing the power amplifier efficiency while simultaneously maintaining amplifier linearity for signals with high peak-to-average power ratios. Yet, the bandwidth of conventional Doherty power amplifiers (DPAs) are limited by phase dispersion of the microstrip impedance transformer (IT). To overcome this phase dispersion requires minimization of the phase delay of the IT. However, doing so will limit further

bandwidth extension. This invention presents a solution by using a broadband Doherty-like PA topology which fuses parallel right- and left-handed ITs, thus extending the frequency range for load modulation. This invention will improve improve the efficiency of power amplifiers used in the 5G base stations for wireless communications.

Technology

The invention uses for the first time a paralleled right and left handed network in both impedance inverters. The proposed Doherty-like power amplifier (DLPA) is comprised of two ITs and two phase tuning lines for both the carrier and peaking devices, followed by a post matching network (PMN). The ITs are comprised of an L-type right-handed microstrip network, which is in parallel with an artificial left-handed quasi-lumped component network. After the carrier and peaking IT design, two phase tuning lines are added to the output of the carrier and peaking branch to compensate for the 90° phase difference between the carrier and peaking device at the current plane. The resulting gain of the designed DPA with respect to the output power at different frequencies are such that for small signal gain, it varies from 10.2 dB to 12.9 dB over the entire operating frequency band. At the 5-6 dB back-off points (38 dBm) from saturation and saturation, the gain ranges from 10.4 dB to 8 dB and from 8.5 dB to 6.2 dB, respectively. The saturated output power ranges from 43 dBm to 44.5 dBm over the entire operating frequency band, while output power @ the 1dB compression point ranges from 32.3 dBm to 37 dBm.

Advantages

- The proposed Doherty-like power amplifier has an ultra-wideband operating bandwidth (60%), which can cover the 4G and coming 5G frequency band.
- It has at least 40% drain efficiency at 6-dB back-off point.
- Extending bandwidth by utilizing the parallel right and left handed impedance inverter, which achieves minimum phase delay but not scarifying load modulation bandwidth.

Applications

- In base station power amplifiers in future wireless communication systems such as 5G because the invention allows operation over an ultra-wideband frequency range.
- The benefit of the invention is independent of frequency. Even in practice it can cover most wireless communication frequency bands making it suitable for deployment in the base stations of 5G wireless communication.