High Efficiency PAs for mm-wave Communication Systems

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Abstract

❑ Modern communication systems use orthogonal frequency division multiplexing (OFDM) which has high peak to average power ratio (PAPR)

❑ This high PAPR requires the system to have high compression point. However, the system requires high efficiency at the average output power (6dB back-off)

❑ The proposed work shows measurement results for a Doherty PA with novel adaptive biasing for 5G communication systems as well as the measurement results for 90GHz isolated combining PA

23-28 GHz Doherty PA with novel adaptive biasing

❑ Doherty PA uses load modulation to provide high PAE at 6dB BOF power.

❑ Differential combining is used to combine both the main and aux amplifiers.

❑ Single transformer is used which helps provide compactness for the whole Doherty PA.

❑ PVT insensitive adaptive biasing circuit is used to enhance the EVM of the system.

❑ Measured results shows around 27% PAE @ 6dB BOF while achieving Psat of more than 20.5 dBm

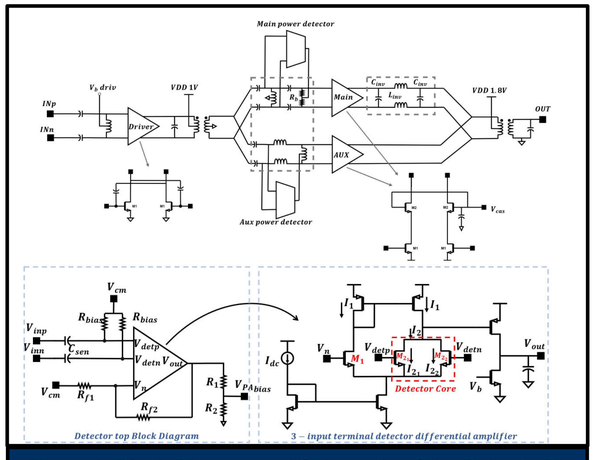

Figure 1: Block Diagram and Schematic of the Doherty PA and proposed adaptive bias circuit

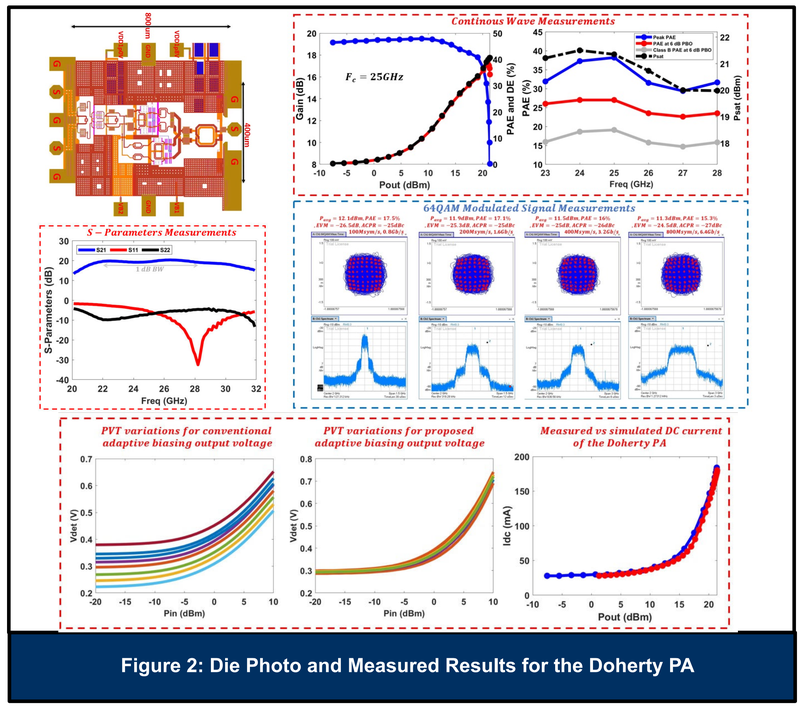

Figure 2: Die Photo and Measured Results for the Doherty PA

90GHz High Efficiency PA using Isolated Combining

❑ This work proposes a high efficiency PA for 90GHz transmitters depending on using isolated combiner between a main and auxiliary amplifier

❑ This isolation between the two PAs prevents any load modulation which is the main difference between this constant load PA and the Doherty PA.

❑ The main amplifier is biased at class AB while the aux amplifier is biased in class C. As the Pin increases the aux amplifier will start working with the main amplifier.

❑ High speed adaptive bias is required for both the main and auxiliary amplifiers to achieve high data rates while minimizing the memory effects

❑ Analysis is done to show that the constant load PA is preferred over the Doherty PA in case of smaller ratio for the PA output resistance compared to the PA optimum resistance.

Measurement results for the 90GHz PA

❑ Measured results shows around 19% peak PAE and around 14% PAE @6dB PBO at 87.5GHz

❑ The measured PAE @6dB PBO is considered the highest compared to any work published in this frequency range

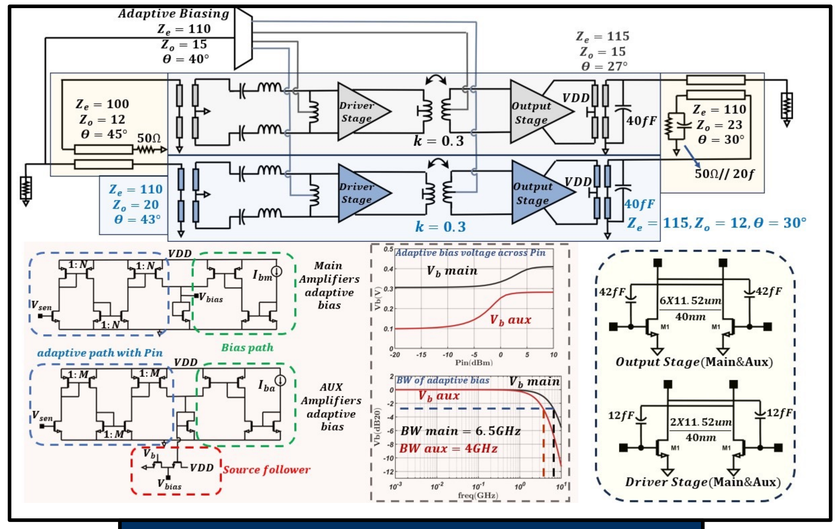

Figure 3: Block Diagram and Schematics of the 90GHz PA

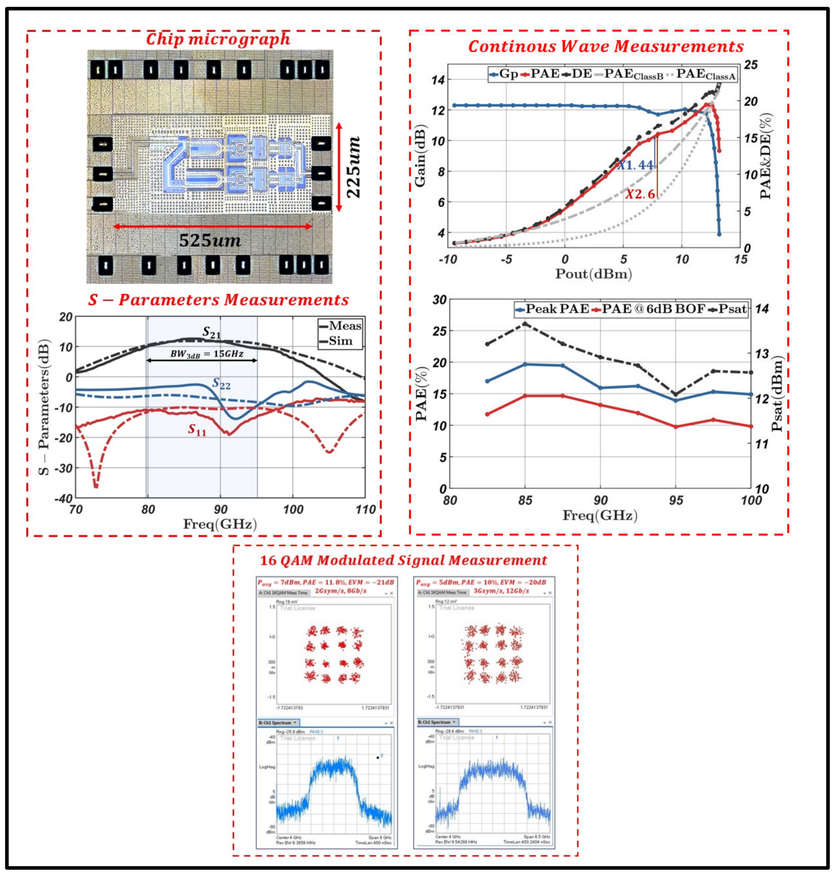

Figure 4: Chip Micrograph and Measurement Results of the proposed PA