



## Load-Modulation Network for High-Efficiency 5G Power Amplifiers

Tech ID: 32586 / UC Case 2021-877-0

### BACKGROUND

The high data rates achieved by 5G wireless networks are enabled by high power amplifier (PA) efficiency. 5G NR waveforms operate at an average power of 11 dB from the peak output power and the PA is less efficient at the average power. Load modulation improves the backoff efficiency of PAs by exploiting the relationship between load impedance, efficiency, and output power. However, conventional approaches require multiple amplifiers and often utilize precise phase and amplitude control on the inputs, making them difficult to implement at millimeter-wave (mm-wave) frequencies. Dynamic load modulation (DLM) optimizes output power efficiency, but most approaches require additional capacitors or varactors, which limits the scaling of DLM to mm-wave bands. Additionally, large banks of switches are generally only feasible in highly scaled CMOS processes, placing limits on the power handling for the network at the output of the PA.

### DESCRIPTION

Researchers at University of California, Santa Barbara have developed a passive outphasing load modulator (POLM) that allows for higher efficiency and linearity of the power amplifier (PA) with a single power amplifier device. This technology switches across a transmission line ring where only one switch is required for each state, enabling low loss and efficient device layout at high frequency. The GaN process' high linearity and enhanced power handling serve to minimize distortion in transmitting — all with a relatively simple network, only requiring one PA for an inherently wideband network exceeding 2.5GHz.

### ADVANTAGES

- ▶ Only requires a single power amplifier
- ▶ Higher output power efficiency
- ▶ Improved signal quality
- ▶ Decreased cost and complexity

### APPLICATIONS

- ▶ 5G cellular networks
- ▶ New radio

### PATENT STATUS

### CONTACT

Pasquale S. Ferrari  
[ferrari@tia.ucsb.edu](mailto:ferrari@tia.ucsb.edu)  
tel: .

### INVENTORS

- ▶ Buckwalter, James F.
- ▶ Hill, Cameron

### OTHER INFORMATION

#### KEYWORDS

RF, switch, GaN, Power  
Amplifier, Load Modulation,  
Millimeter-Wave, 5G, PA

#### CATEGORIZED AS

- ▶ **Communications**
  - ▶ Internet
  - ▶ Networking
  - ▶ Other
  - ▶ Wireless
- ▶ **Engineering**
  - ▶ Other

#### RELATED CASES

2021-877-0

Country	Type	Number	Dated	Case
United States Of America	Published Application	20230353105	11/02/2023	2021-877

## ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- ▶ [Improved Dynamic Range in RF Communication Over Optical Fiber](#)

University of California, Santa Barbara  
Office of Technology & Industry Alliances  
342 Lagoon Road, Santa Barbara, CA 93106-2055 |  
[www.tia.ucsb.edu](http://www.tia.ucsb.edu)  
Tel: 805-893-2073 | Fax: 805.893.5236 | [padilla@tia.ucsb.edu](mailto:padilla@tia.ucsb.edu)



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