A 26GHz 22.2dBm Variable Gain Power Amplifier in 28nm FD-SOI CMOS for 5G Antenna Arrays

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Presentation Outline

- Motivation and Scope
- Architecture
- Design
- Simulation and measurement results
- Conclusions

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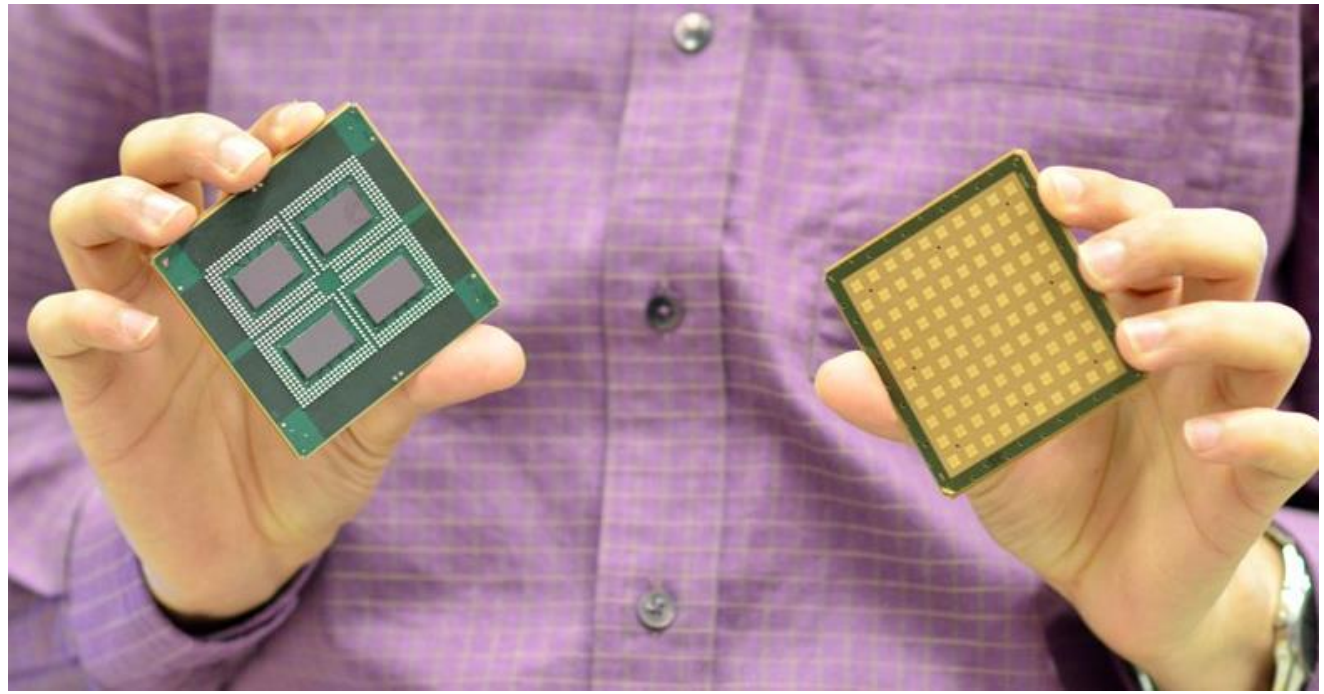
Motivation and Scope

- Targeting 5G mmW base station
- Large antenna array
- High integration
  - Not possible with external PAs
  - Many trancievers per chip
  - Including digital baseband
- State of the art CMOS



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Motivation and Scope

- 5G mmW PA for Antenna Array System (AAS)
  - High output power
    - » For coverage at mmW
  - 28 nm FD-SOI CMOS process
  - High Power Added Efficiency (PAE)
  - 10-year reliability

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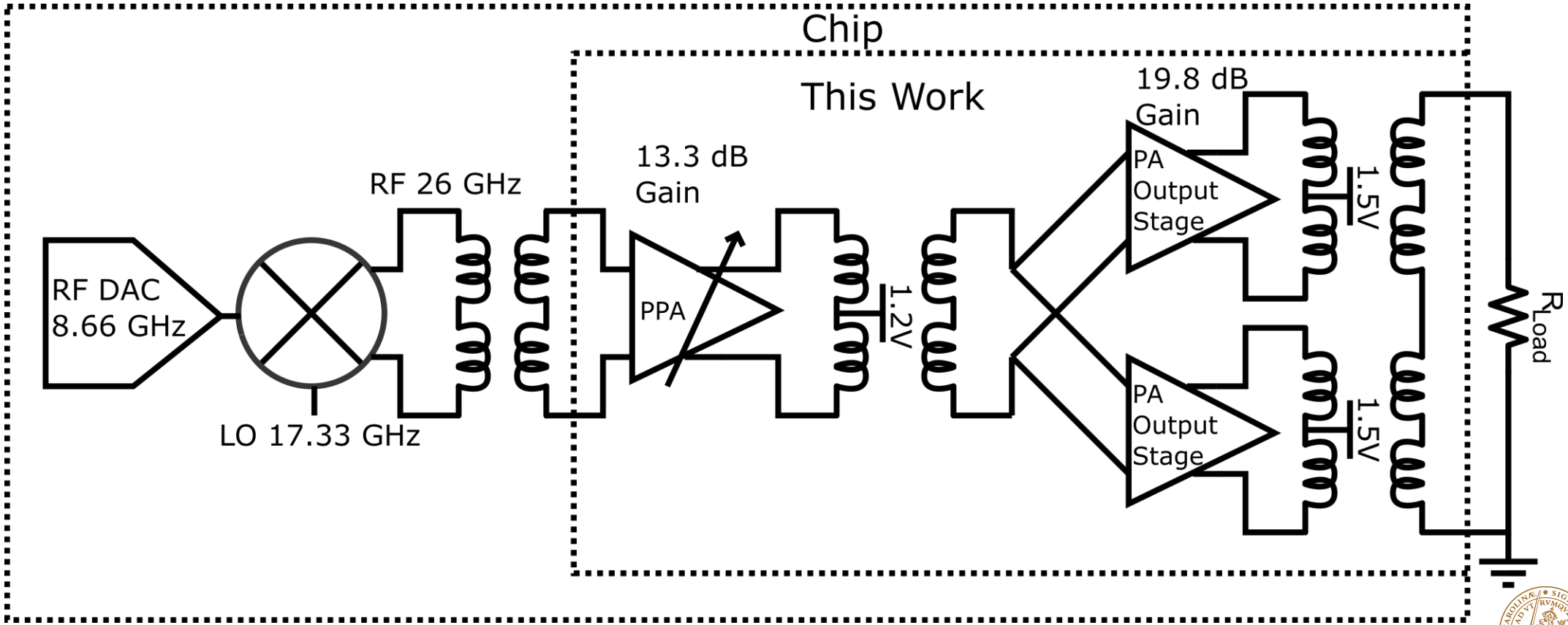
PA Architecture –Part of a fully integrated transmitter



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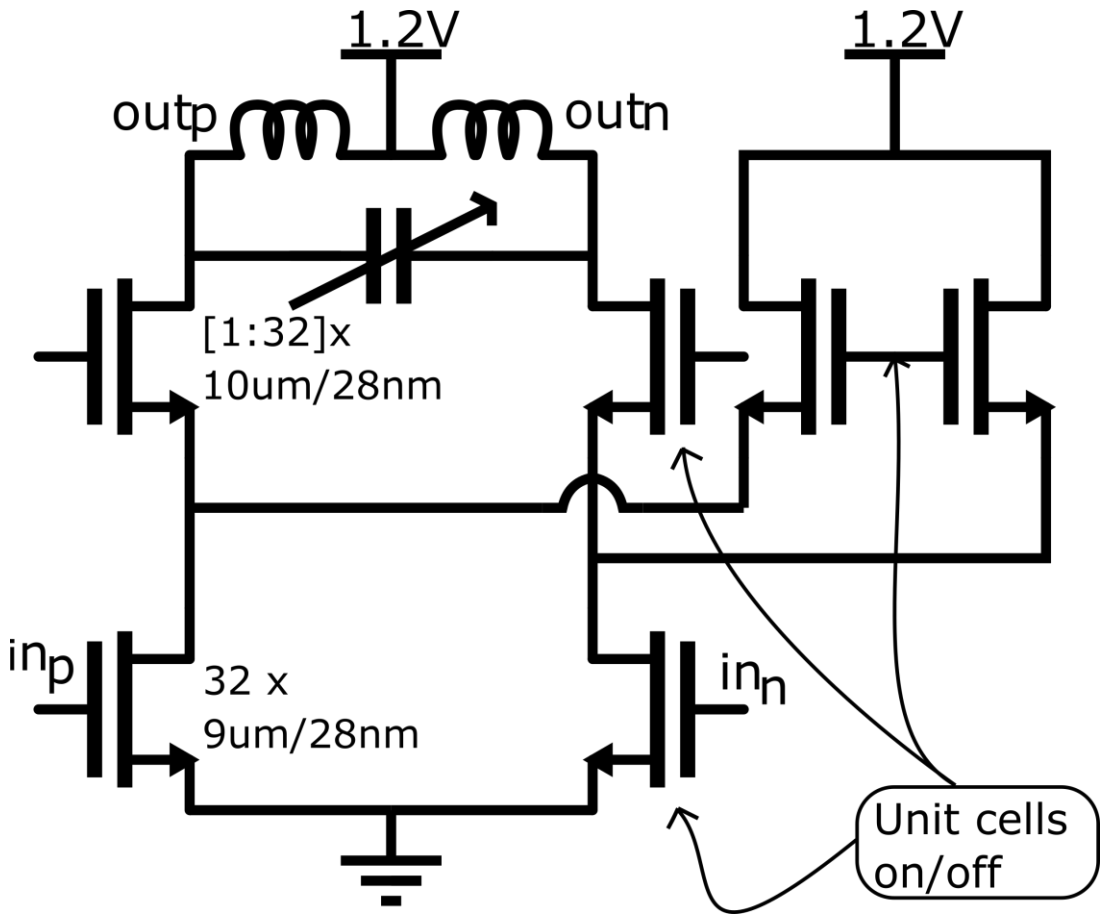
PPA Design



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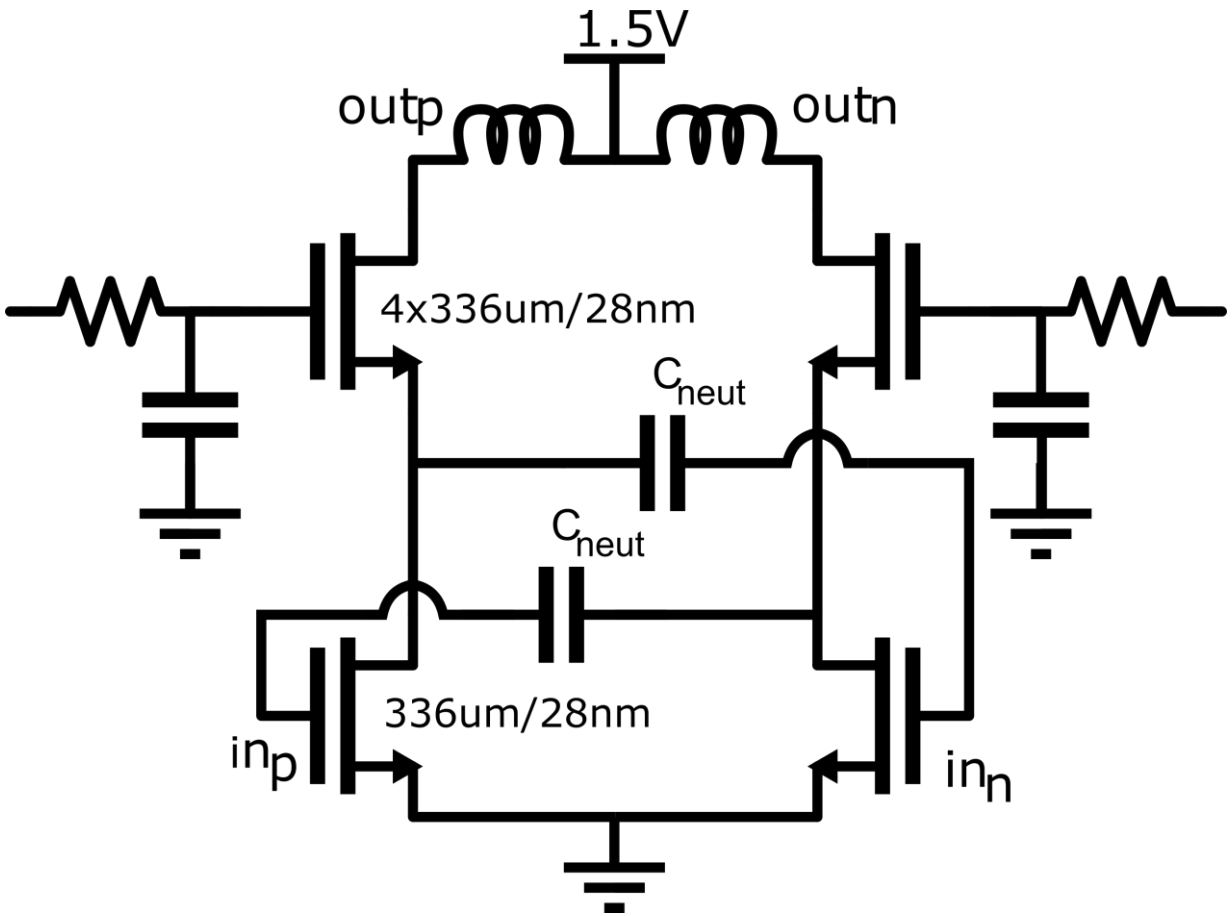
Sub-PA Design



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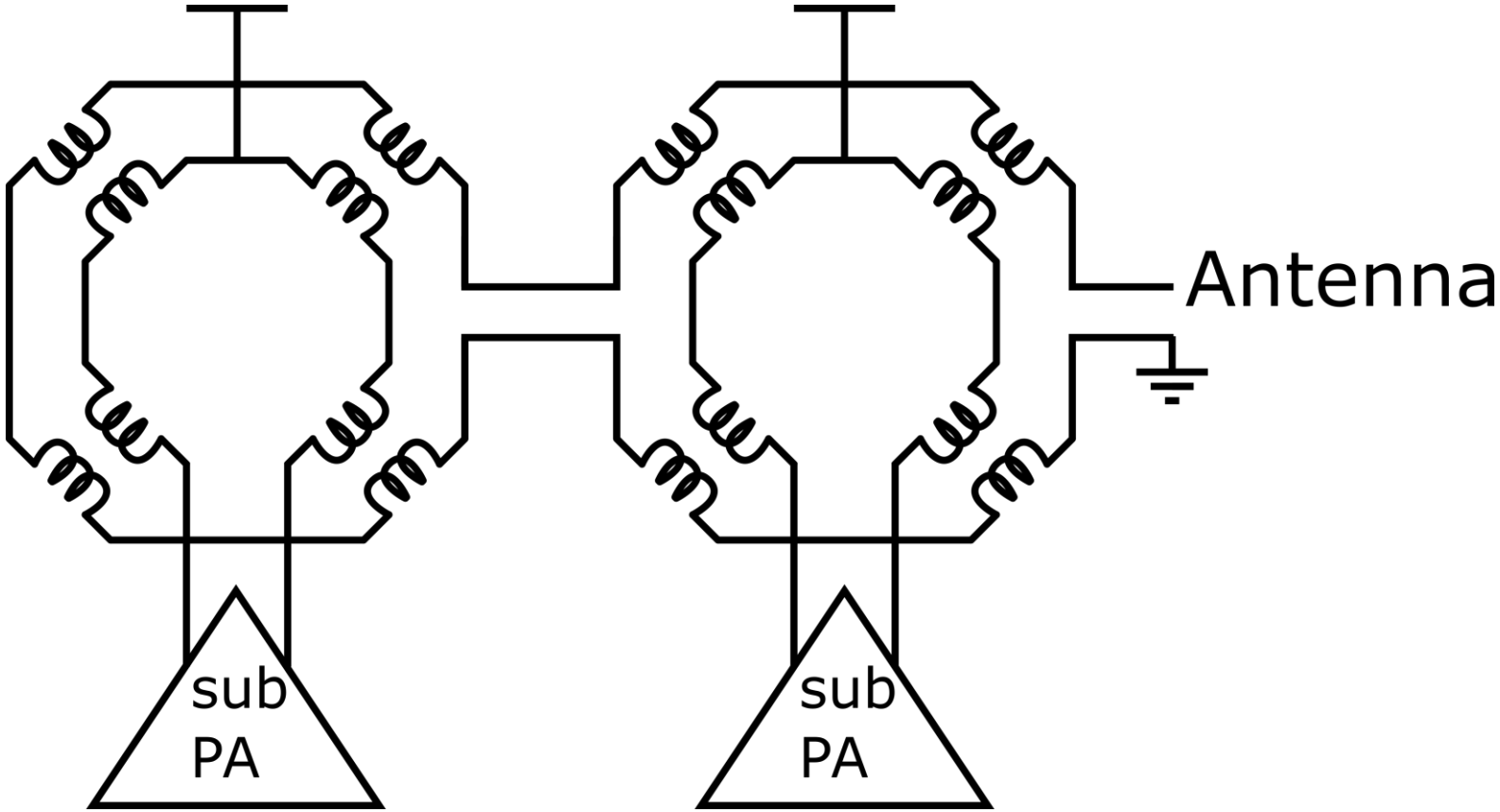
Output Combiner Design



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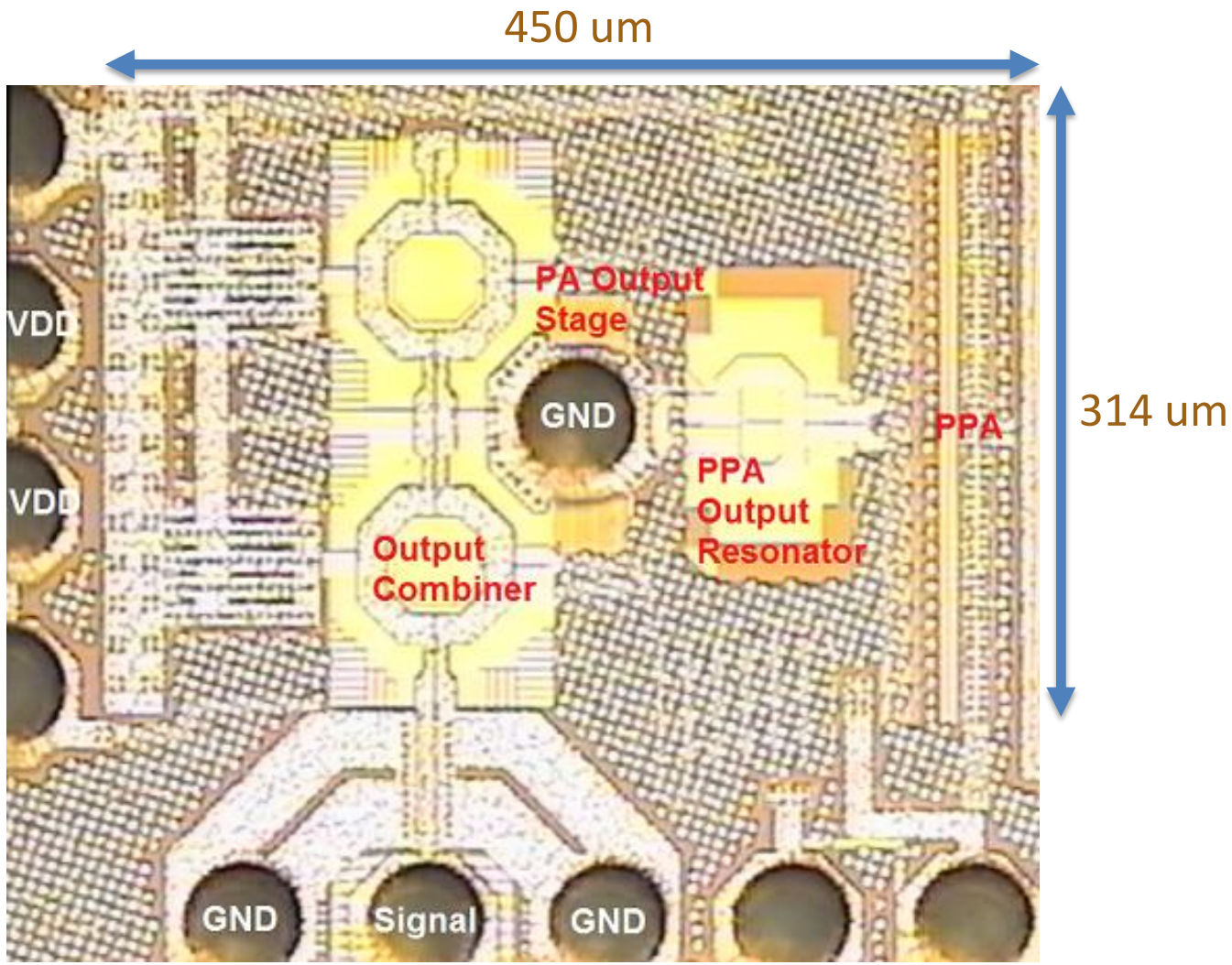
Chip Photo



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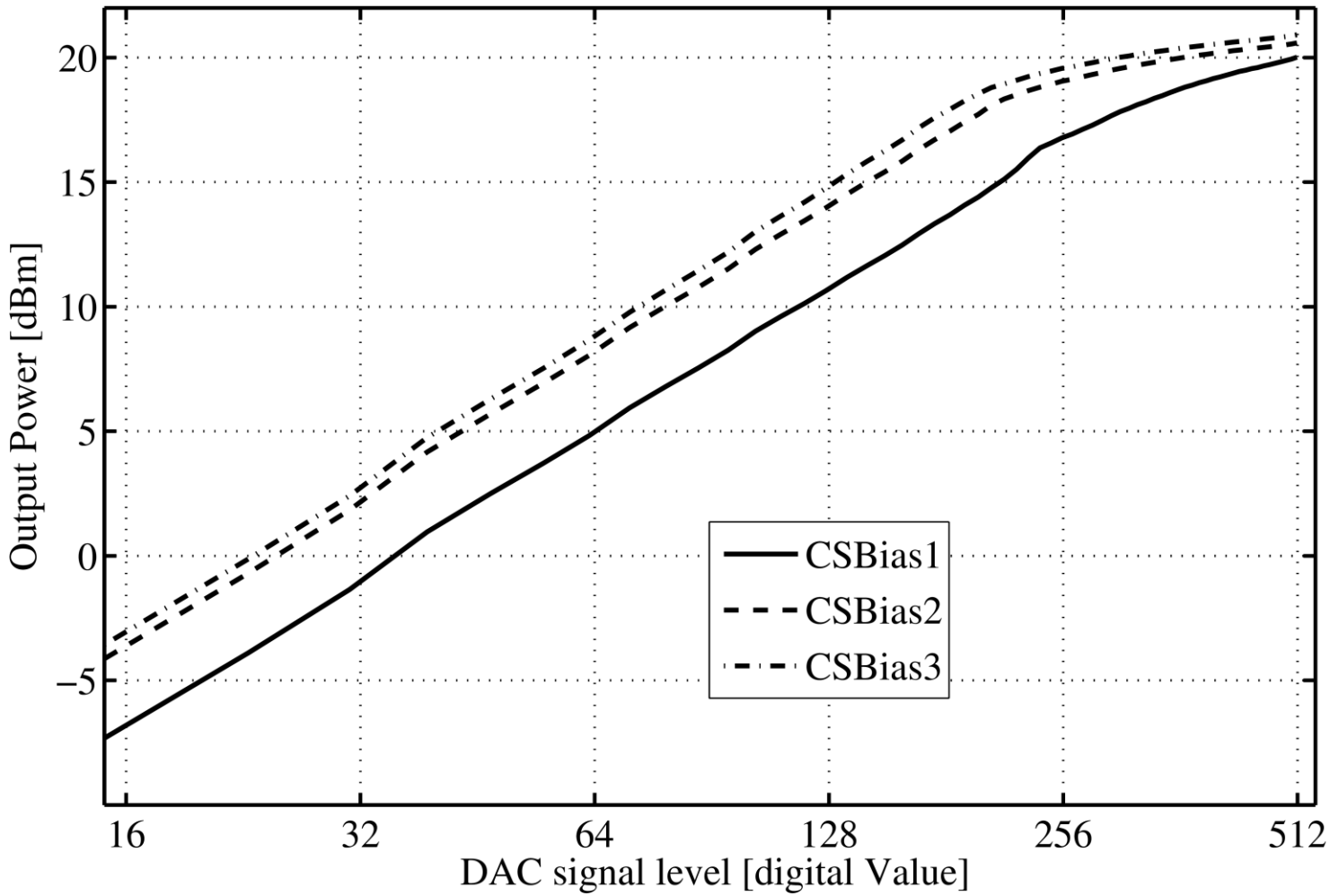
Pout vs DAC value



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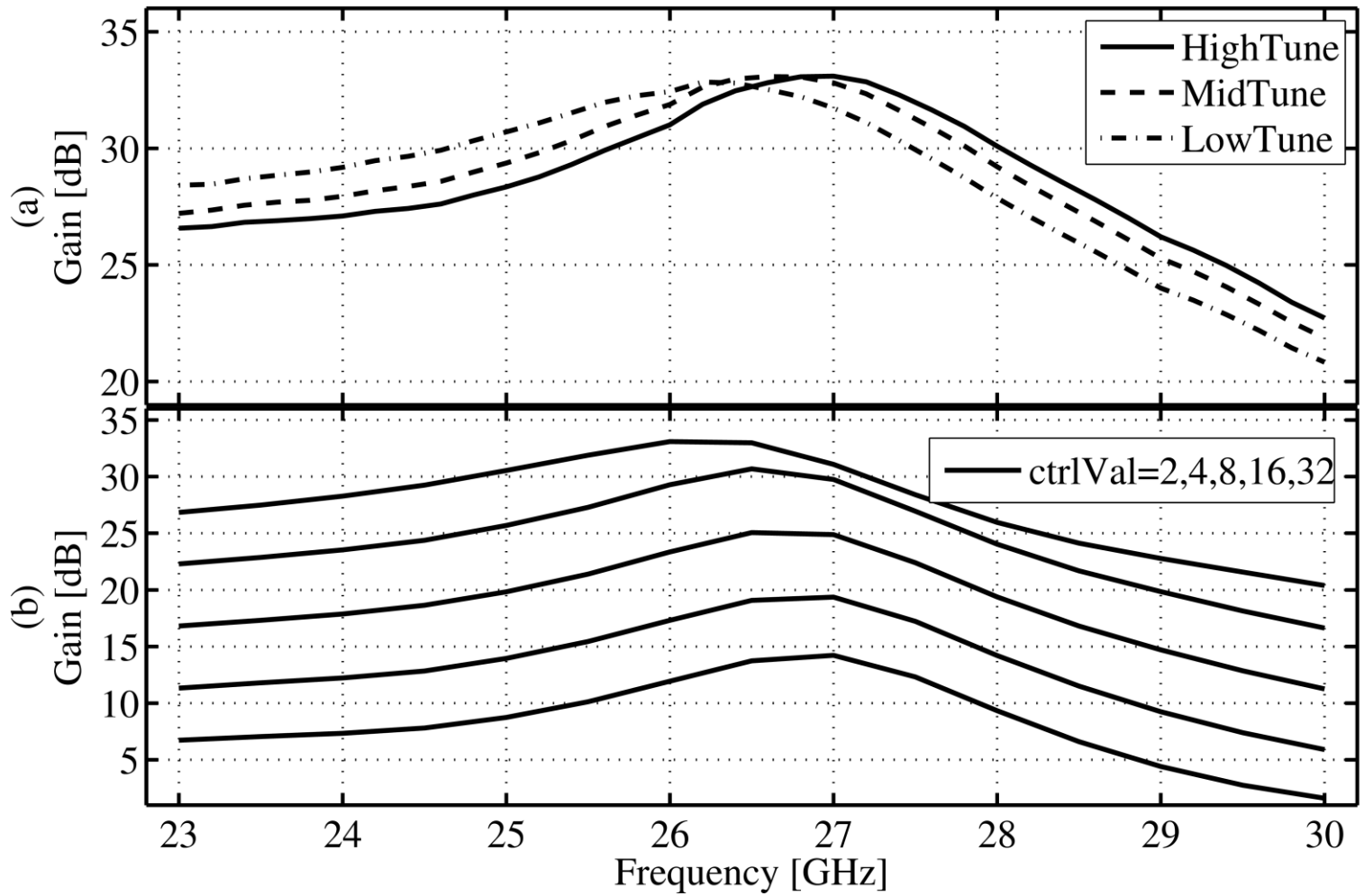
Small Signal Measurement



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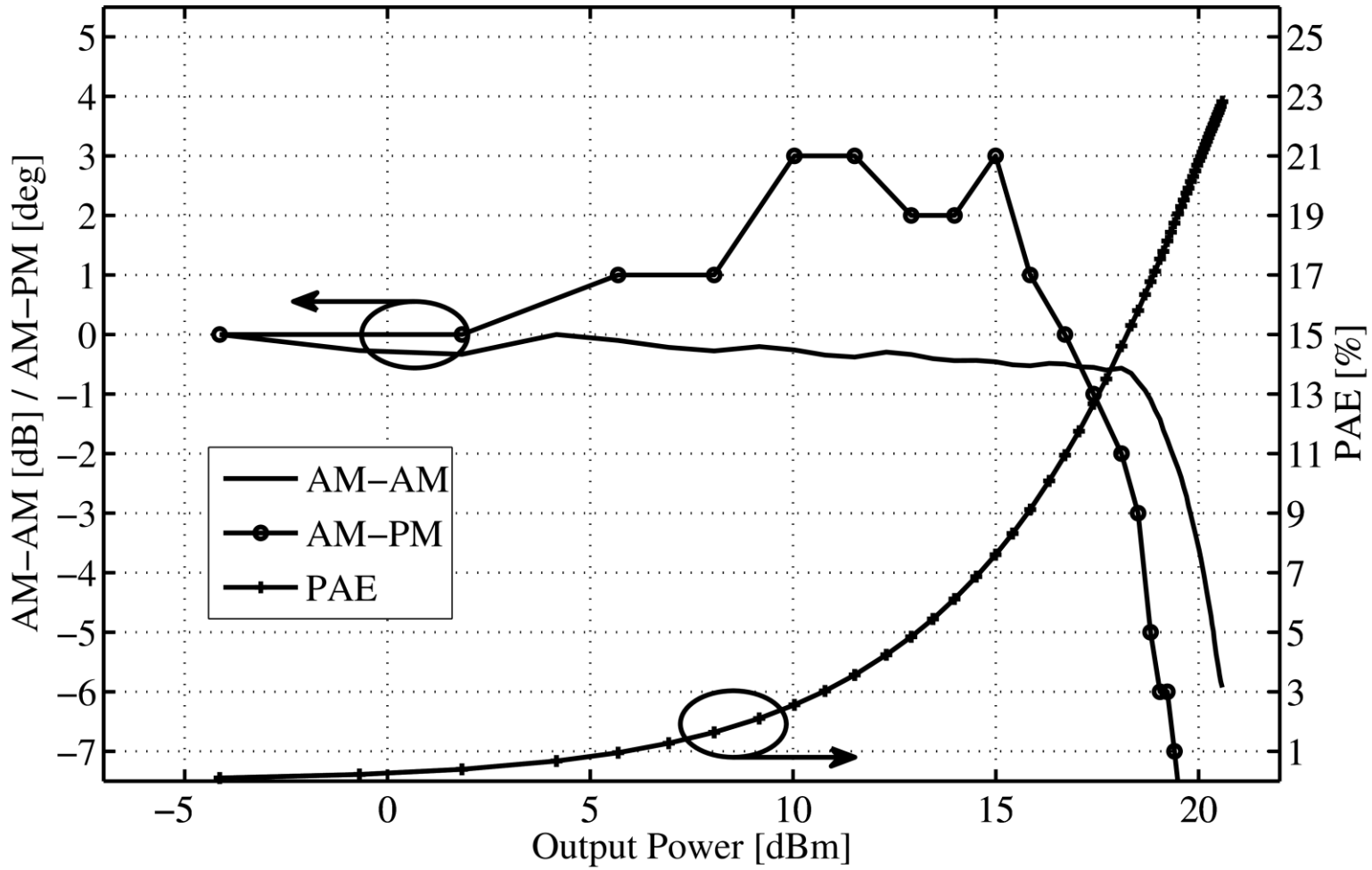
AM-AM, AM-PM and PAE



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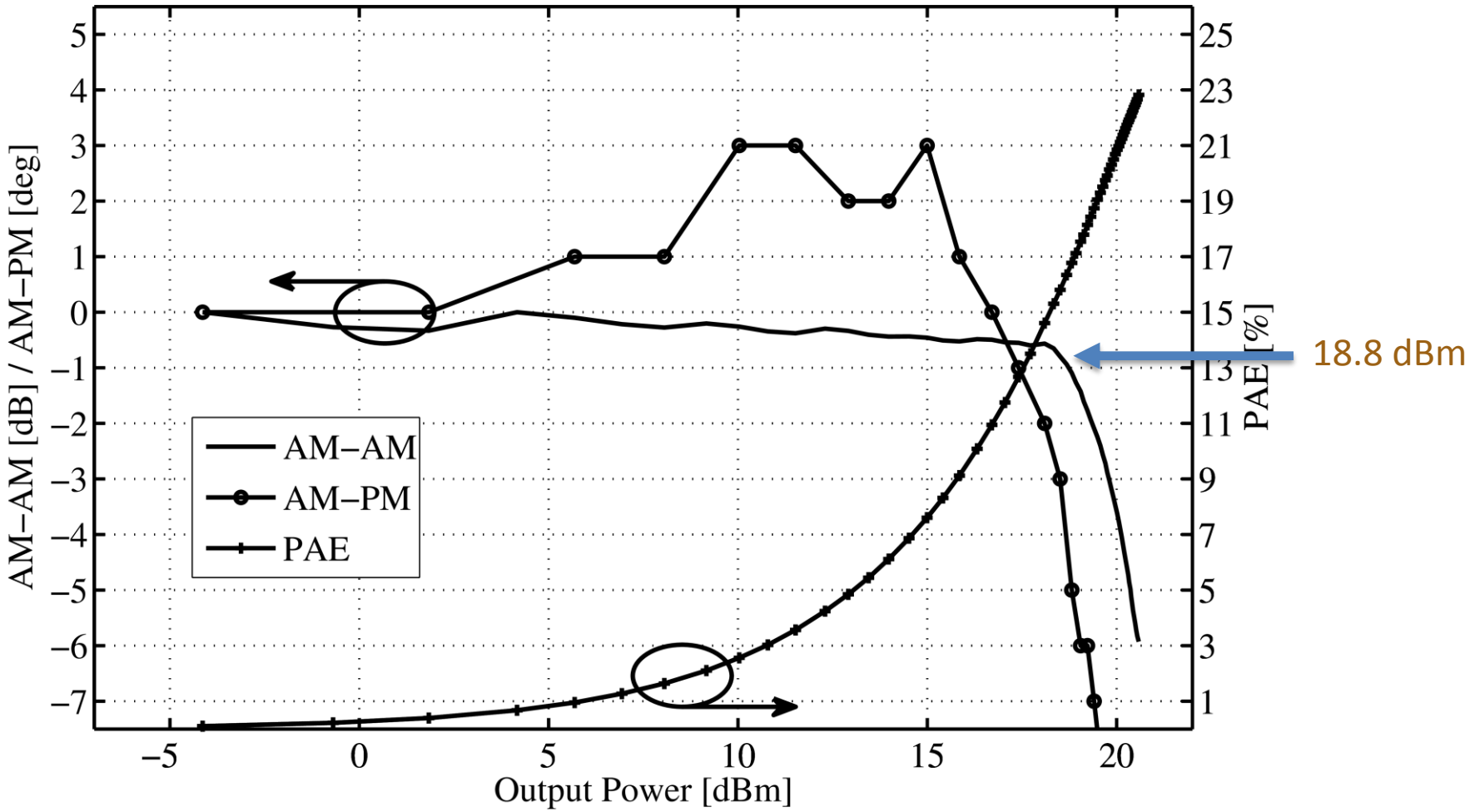

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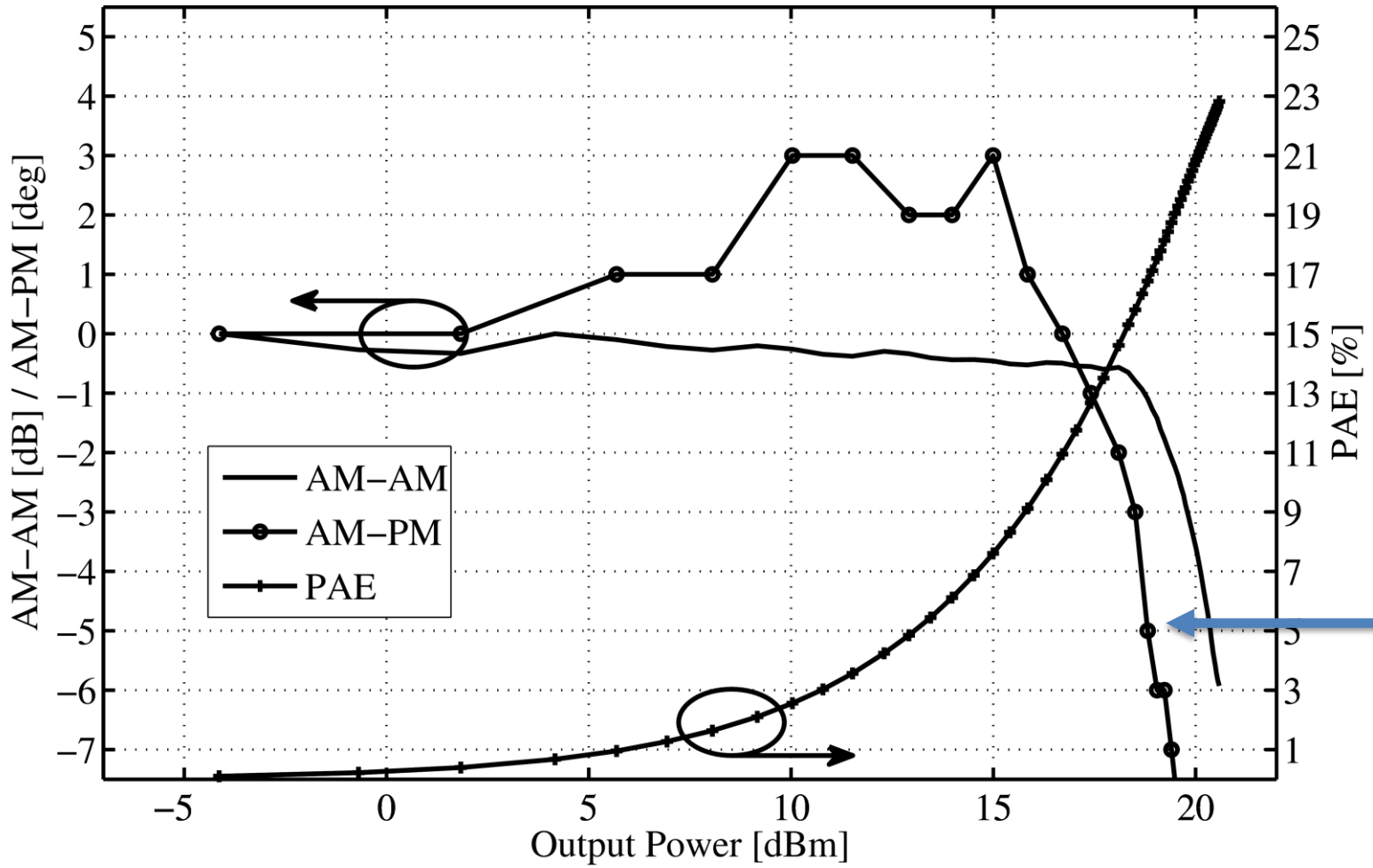

5 degrees

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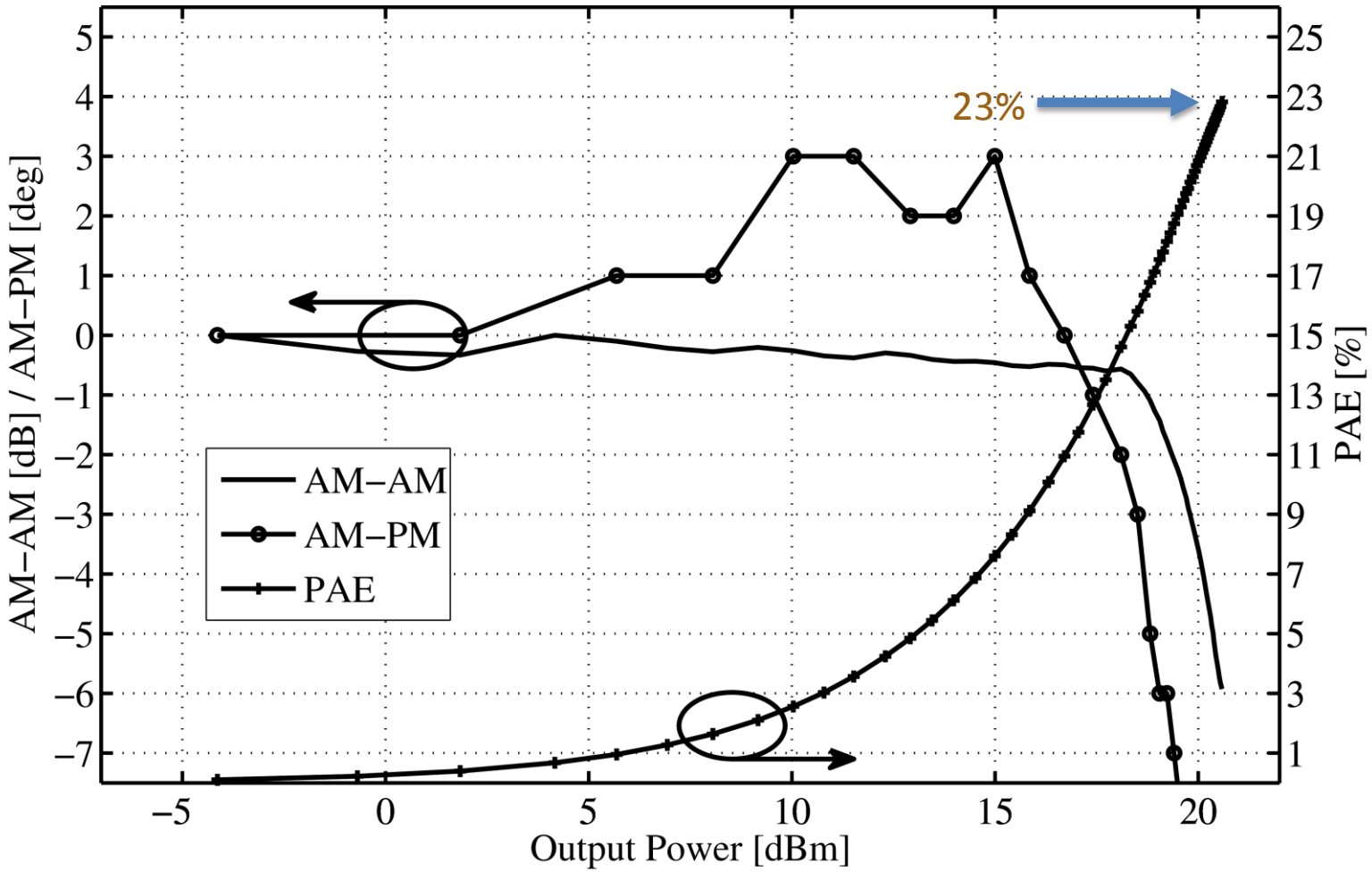

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Performance Summary and Comparison

Parameter	This Work		RFIC'17 [3]	RFIC'17 [4]	ISSCC'16 [5]		IMS'16 [6]	
Tech. [nm]	28 SOI CMOS		28 Bulk CMOS	28 Bulk CMOS	28 Bulk CMOS		28 Bulk CMOS	
Freq. [GHz]	26		27	32	30		28	
Pwr.Comb.	2		2	2	1		1	
Gain Control	5 bits, 19dB		None	None	None		None	
No. of Stages	2		2	2	2		1	
Vdd [V]	1.5	1.8	1	1	1	1.15	1.1	2.2
P_{sat} [dBm]	20.6	22.2	18.1	19.8	14	15.3	14.8	19.8
P_{1dB} [dBm]	18.8	20.7	16.8	16	13.2	14.3	14.0	18.6
PAE_{max} [%]	$22.6^{(1)}$	$21.3^{(1)}$	41.5	21	35.5	36.6	36.5	43.3
PAE_{1dB} [%]	$16.6^{(1)}$	$14.6^{(1)}$	37.6	12.8	34.3	35.8	35.2	41.4
PAE_{max} [%]	$20^{(2)}$	$19.6^{(2)}$	41.5	21	35.5	36.6	36.5	43.3
PAE_{1dB} [%]	$14.5^{(2)}$	$13.5^{(2)}$	37.6	12.8	34.3	35.8	35.2	41.4
Gain [dB]	$33.1^{(3)}$	$33.9^{(3)}$	20.5	22	15.7	16.3	10.0	13.6
Area [mm^2]	0.144		0.361	0.59	0.16		0.28	

$^{(1)}$ Not including PPA power consumption.
$^{(2)}$ Including PPA power consumption.
$^{(3)}$ Simulated value since input signal is generated internally. Also used for calculating PAE values.

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Conclusions

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  - 1dB comp. = 20.7 dBm
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  - Smallest die area

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