



A Sub-THz SiGe DHBT Power Amplifier Using Slotline-based Power Combiner

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Introduction

Advantages of the THz Band:

- The wide frequency range enables the development of ultra-high-speed wireless communication systems.
- The THz band is suitable for various applications, such as radar, imaging systems, and optical signal processing.

The needs of power amplifier (PA)

- To enable the aforementioned applications, a high-output power source is necessary.
- There is a need for low-loss and wideband power combining structures to enhance the power output.

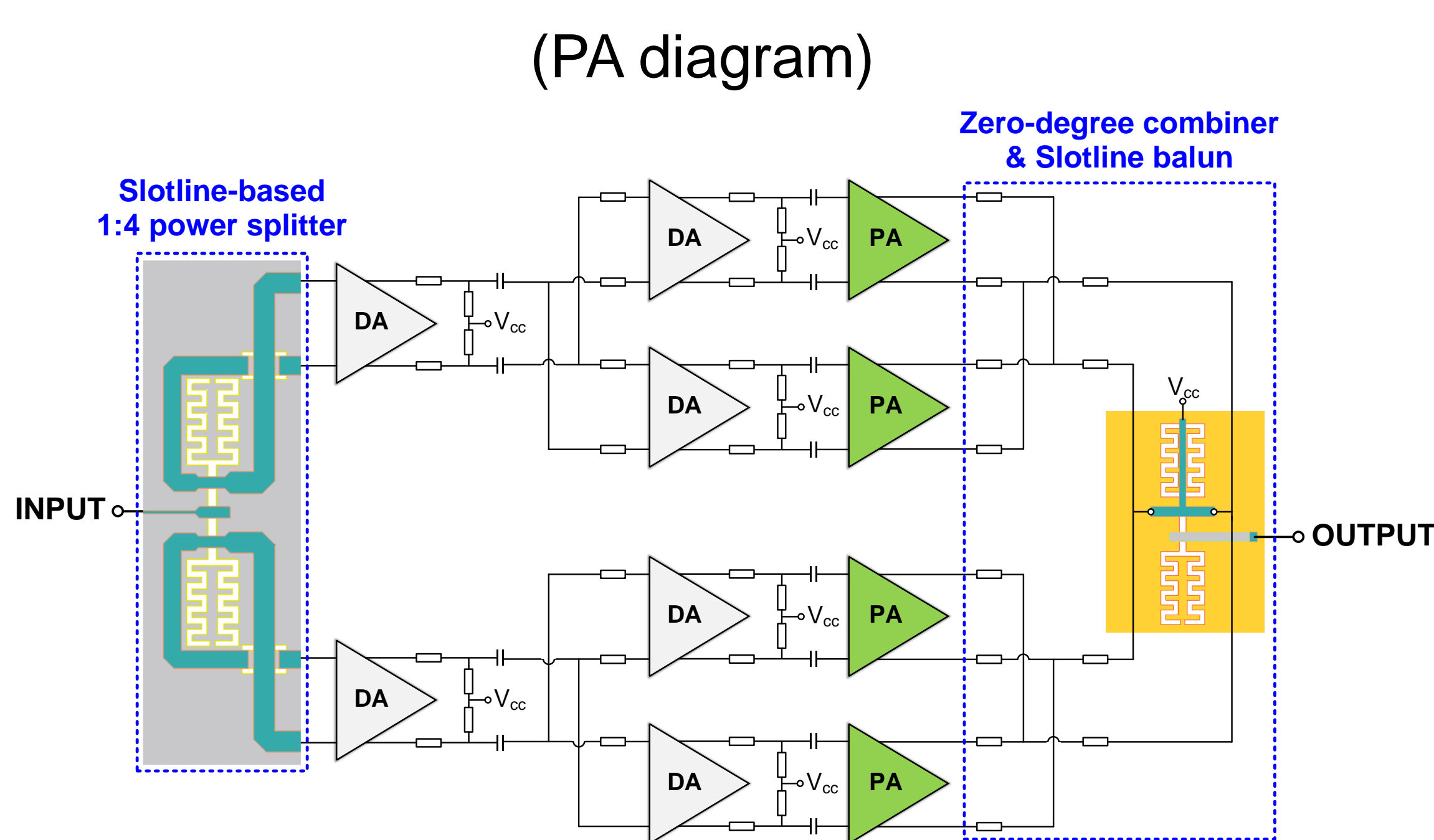
Design

Output matching network design

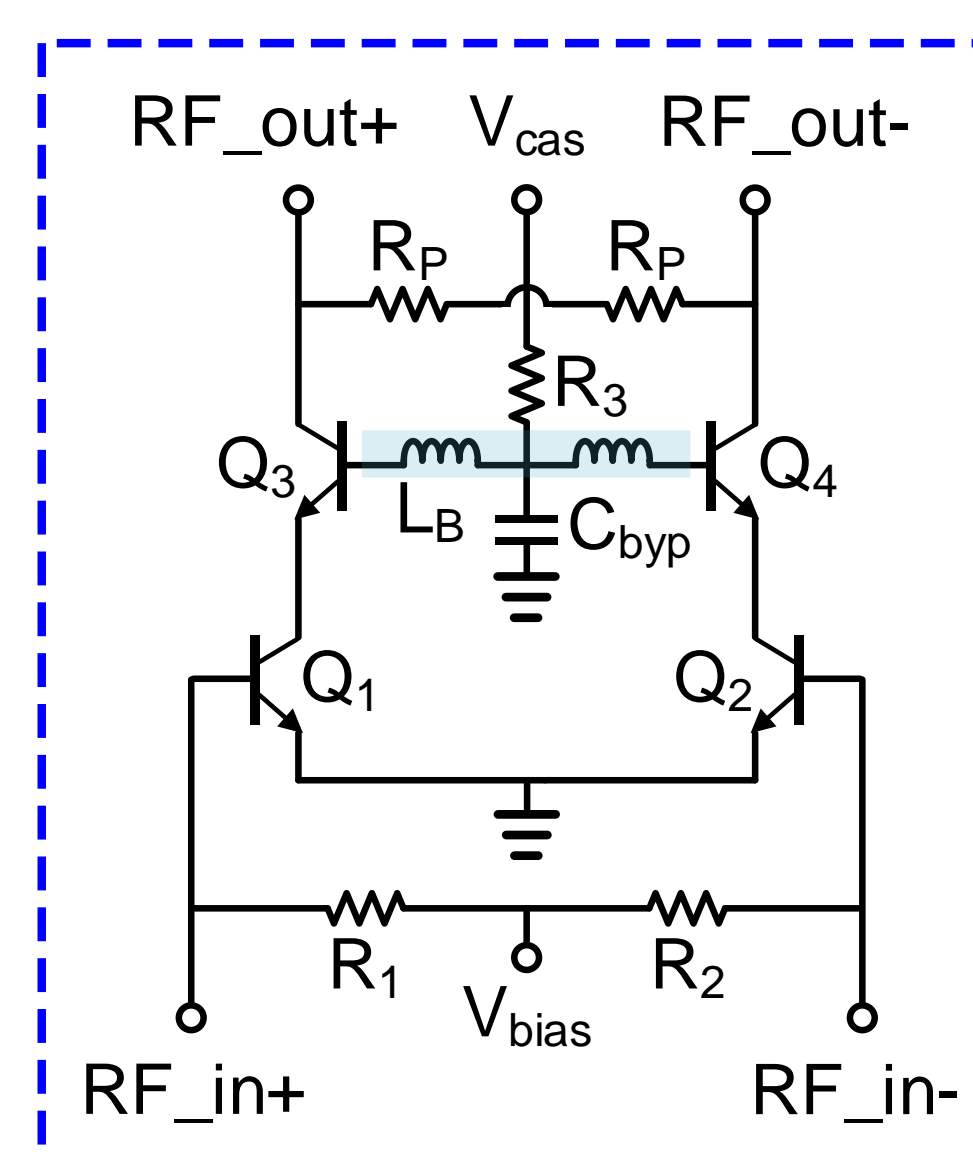
- The slotline-based balun is designed to effectively minimize the imbalance of differential signals by removing the even-mode components. This addresses issues such as oscillation and gain reduction that can occur in differential circuits.
- Slotline-based 1:4 power splitter with extra insertion loss of 0.8–1.7 dB over the range of 160–280 GHz.
- Zero-degree combiner is used for output matching and power combining.

PA core design

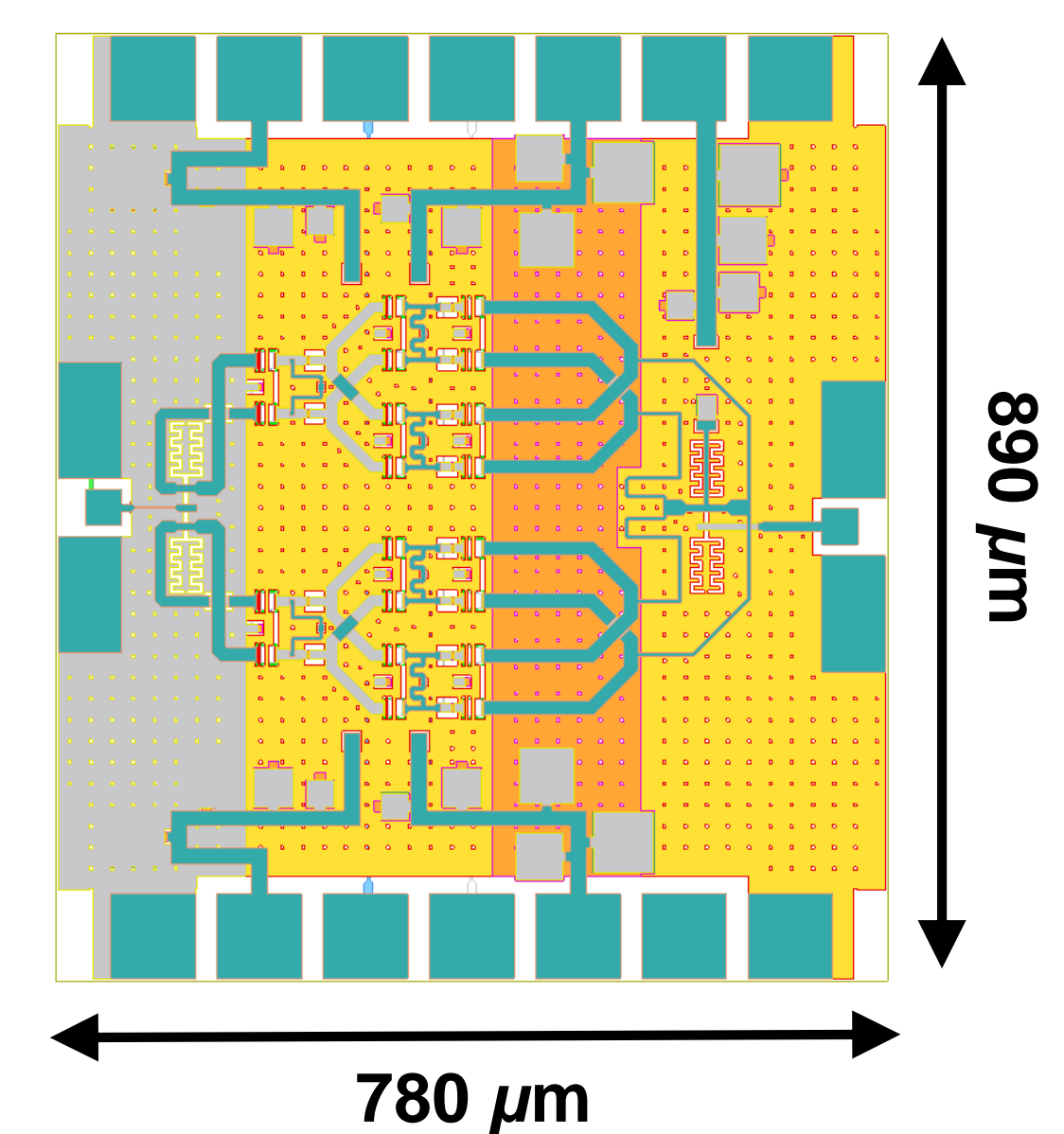
- A differential cascode topology is adopted at the DA and PA units for high small-signal gain and output power.
- A shunt resistor (R_p) is introduced at the output of the DA unit to improve the stability.



(DA & PA units)



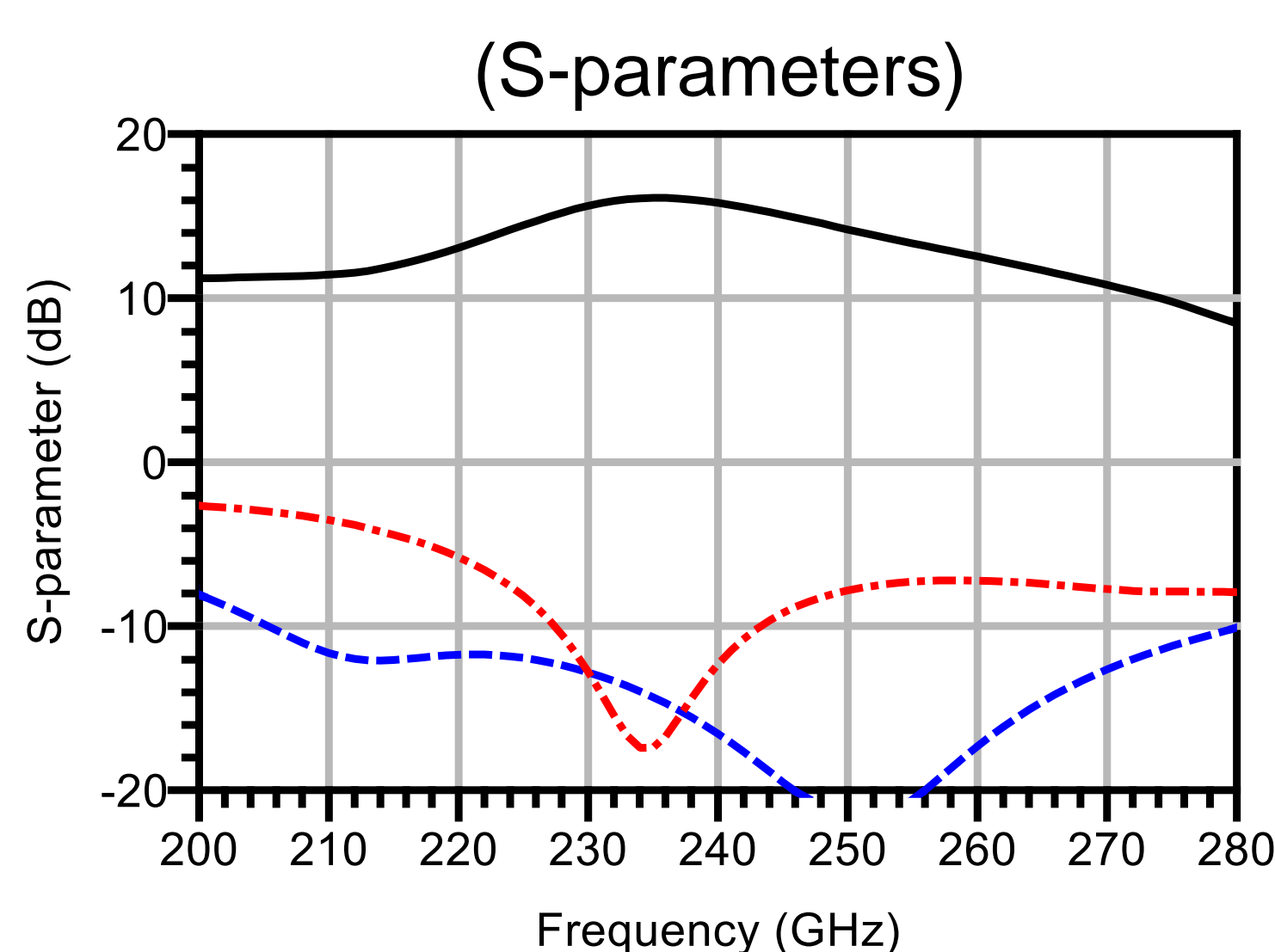
(PA layout)



Results

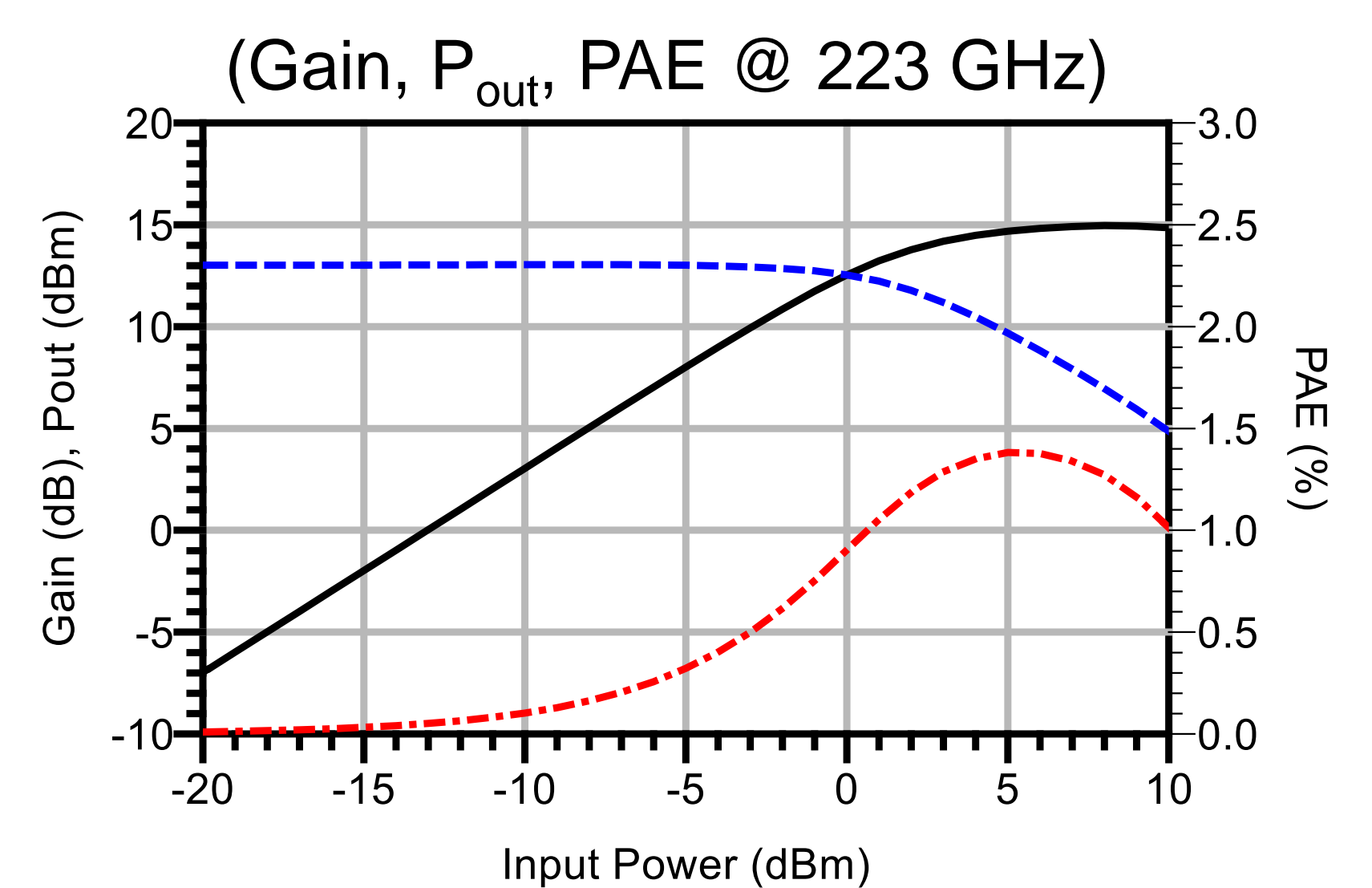
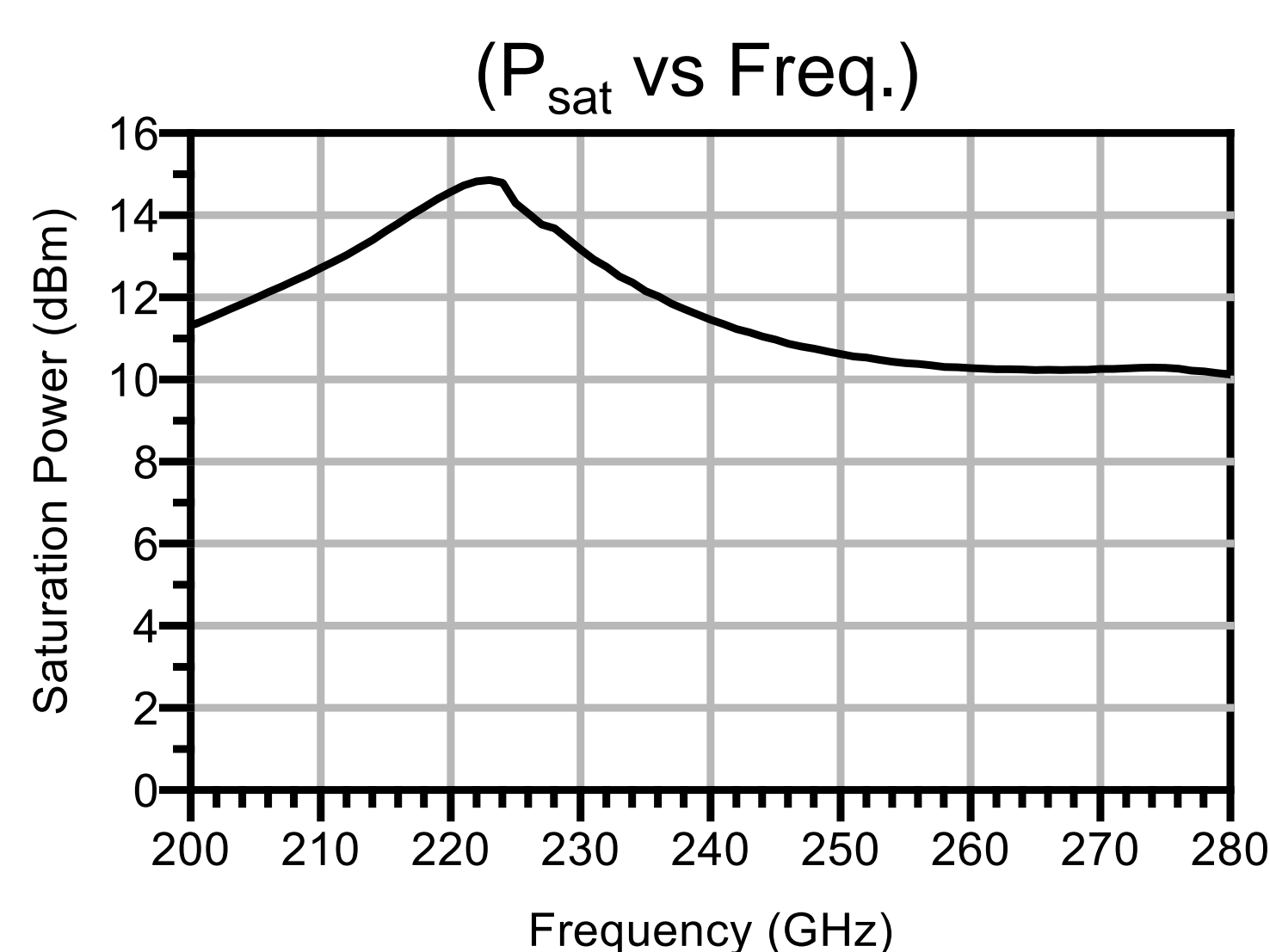
S-parameters simulation

- Peak $S_{21} = 16.1$ dB @ 235 GHz
- 3-dB BW = 40 GHz (220–260 GHz)



Large-signal simulation

- Output power : 14.9 dBm @ 223 GHz
- Peak PAE : 1.4 % @ 223 GHz



Conclusion

- We have developed a slotline-based power amplifier using the SiGe DHBT process.
- The PA demonstrates high output power, with 14.9 dBm at 223 GHz.

The chip fabrication and EDA tool were supported by the IC Design Education Center (IDEC), Korea