IDEC Chip Design Contest

Differential PA and Dual-Band LNA in 28nm FD-SOI for 6G Upper-Mid Band Beamforming

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• Introduction

- ✓ **Candidate 6G bands** identified at WRC-23 include 4.4–4.8 GHz, 7.125–8.4 GHz, and 14.8–15.35 GHz.
- ✓ This work presents a single PA, LNA chip implemented in Samsung 28-nm FD-SOI for 7–24 GHz beamforming front-end applications.
- ✓ This poster focuses on the **differential PA** and **dual-band LNA** design.

• Description

◆ Design of PA

- ✓ The differential cascode PA suppresses ground-induced source degeneration through a virtual-ground source node.
- ✓ 2-stage PA structures were designed for the **14–15 GHz** FR3 band, using input/output baluns for single-ended-to-differential conversion.
- ✓ Load-pull/HB and EM-based transformer design predict 19.7 dB gain, 18.5 dBm OP1dB, 20 dBm Psat, and about 61% peak PAE.

◆ Measurement of PA

- ✓ The fabricated 2-stage PA show about 27–28 dB peak gain.
- ✓ Measured S-parameters generally follow simulation trends, with differences mainly caused by passive loss, parasitic effects, and de-embedding limitations.

◆ Design of LNA

- ✓ A 2-stage cascode dual-band LNA was designed for **7.125–8.4 GHz and 12.7–15.35 GHz**.
- ✓ Interstage notch filters with variable capacitors enable simultaneous dual-band operation and reconfigurable band selection.
- ✓ The simulated gain/NF are 18.8–20.4 dB / 2.4–2.9 dB at the low band and 15.1–16.7 dB / 3.2–3.7 dB at the high band, with 30.4 mA current consumption.

◆ Measurement of LNA

- ✓ The fabricated LNA exhibited lower measured gain than the simulated target.
- ✓ Correlation analysis is in progress, focusing on calibration/probing, bias condition, process/model mismatch, passive/layout parasitics, and stability issues.

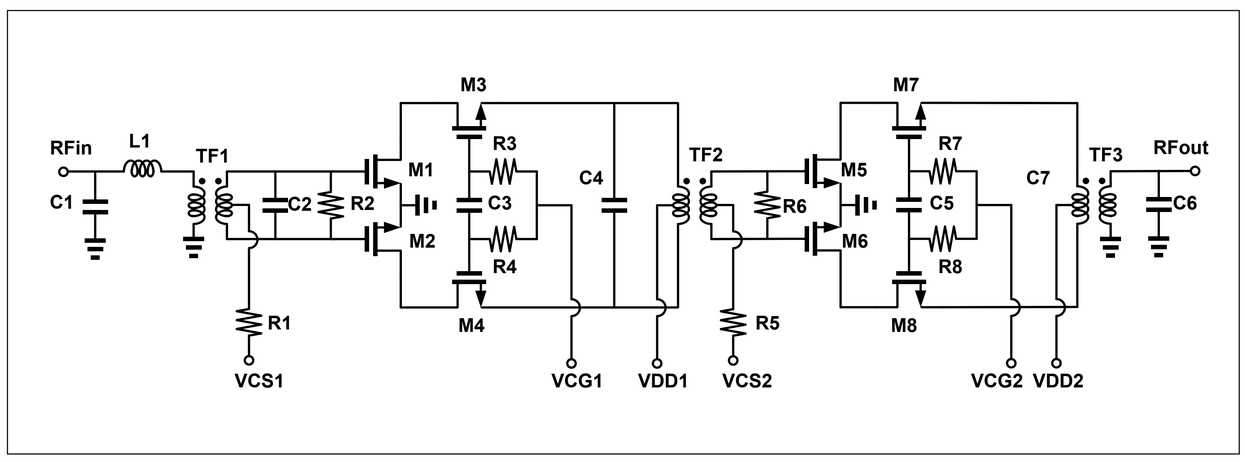

Fig 1. The schematic of PA

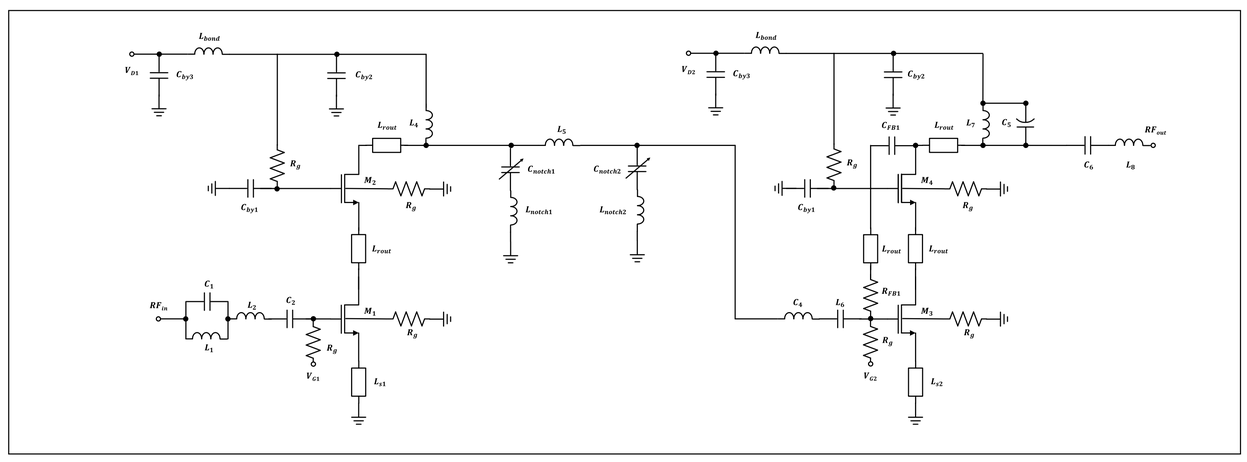

Fig 2. The schematic of LNA

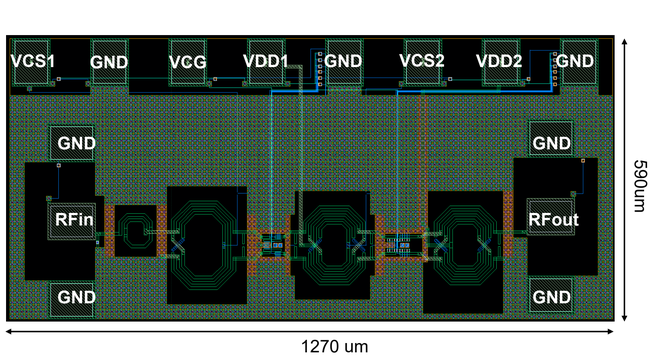

Fig 3. The layout of PA

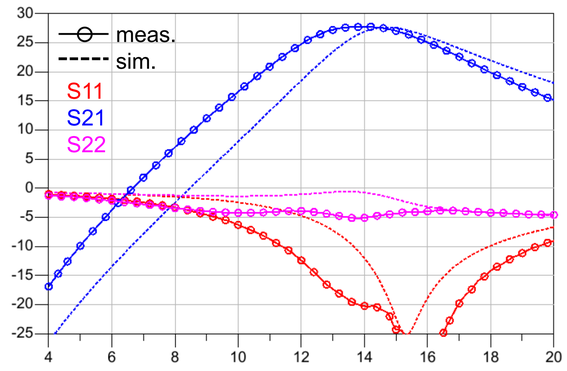

Fig 4. The S-parameter measurement of PA

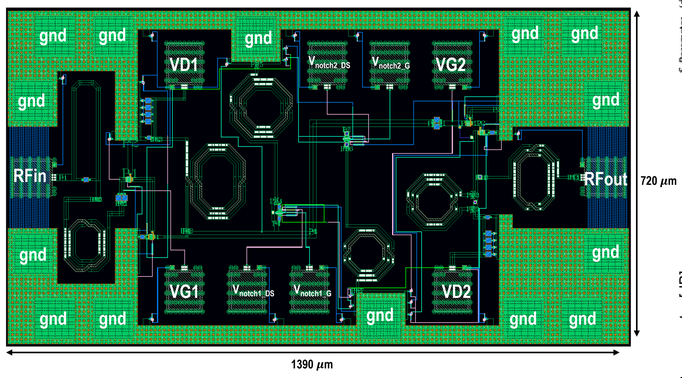

Fig 5. The layout of LNA

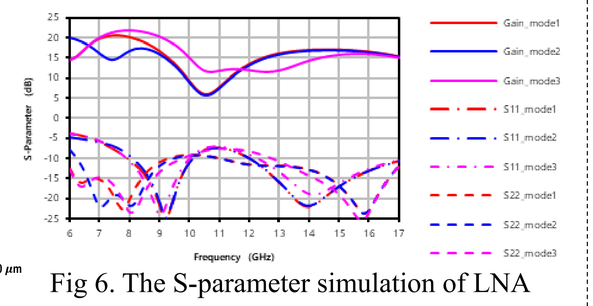

Fig 6. The S-parameter simulation of LNA

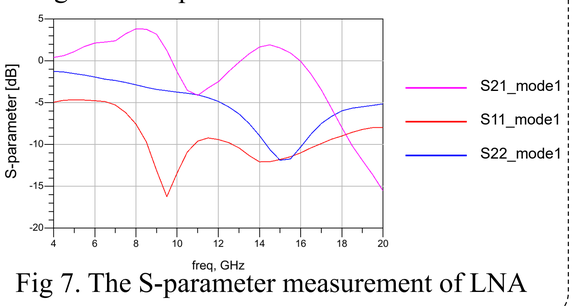

Fig 7. The S-parameter measurement of LNA

• Conclusion

- ✓ A differential cascode PA and a dual-band reconfigurable LNA were designed in 28-nm FD-SOI for 6G upper-mid-band beamforming applications.
- ✓ The PA improves gain by suppressing source degeneration and Miller feedback. The LNA achieves dual-band/reconfigurable operation using interstage tunable notch filters with limited NF penalty.
- ✓ PA measurement shows reasonable agreement with simulation, while LNA correlation is being continued for the next revision.