IDEC Chip Design Contest

A WR-3.4 Band Amplifier-Frequency-Doubler-Chain based on 28-nm CMOS Technology

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Introduction

Wideband signal sources are widely adopted in various applications, such as ultra-high-speed communication systems and high-resolution radar systems.[1]. In this work, a WR-3.4 band Amplifier-Frequency-Doubler-Chain (AFDC) is designed as a part of signal source based on 28-nm CMOS technology.

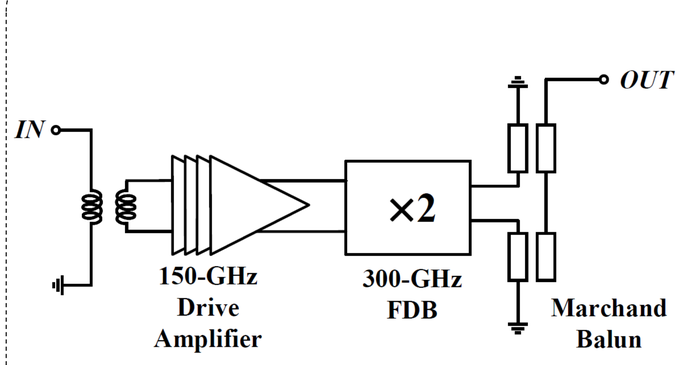
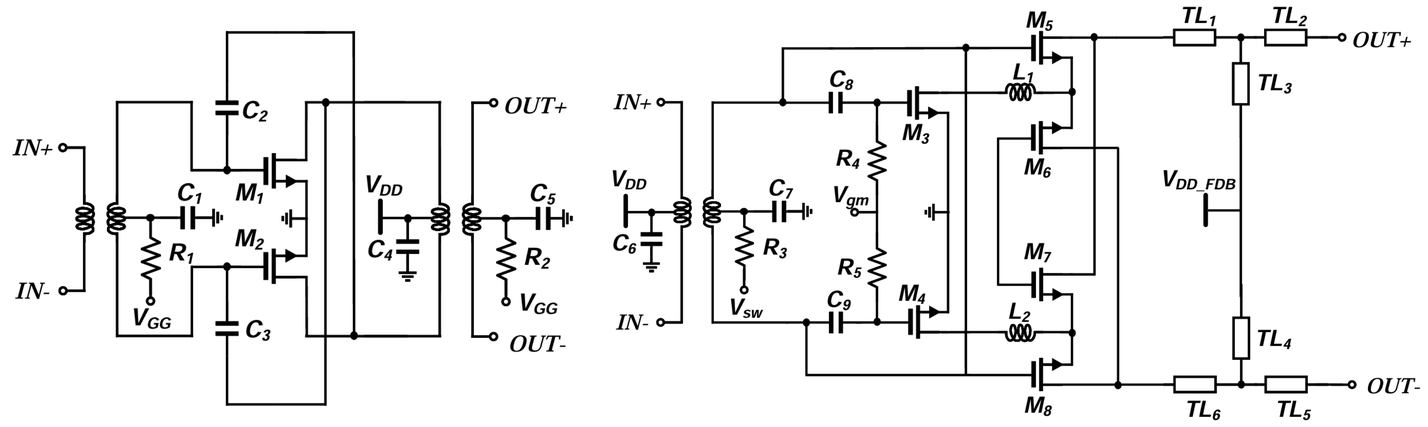


Fig. 1. Block diagram of the WR-3.4 band Frequency Doubler



(a) (b)

Fig. 2. Schematic of (a) unit-stage of drive amplifier and (b) gilbert-cell based frequency doubler .

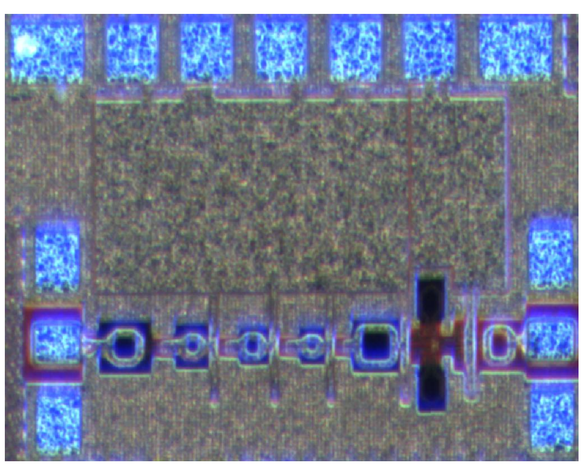
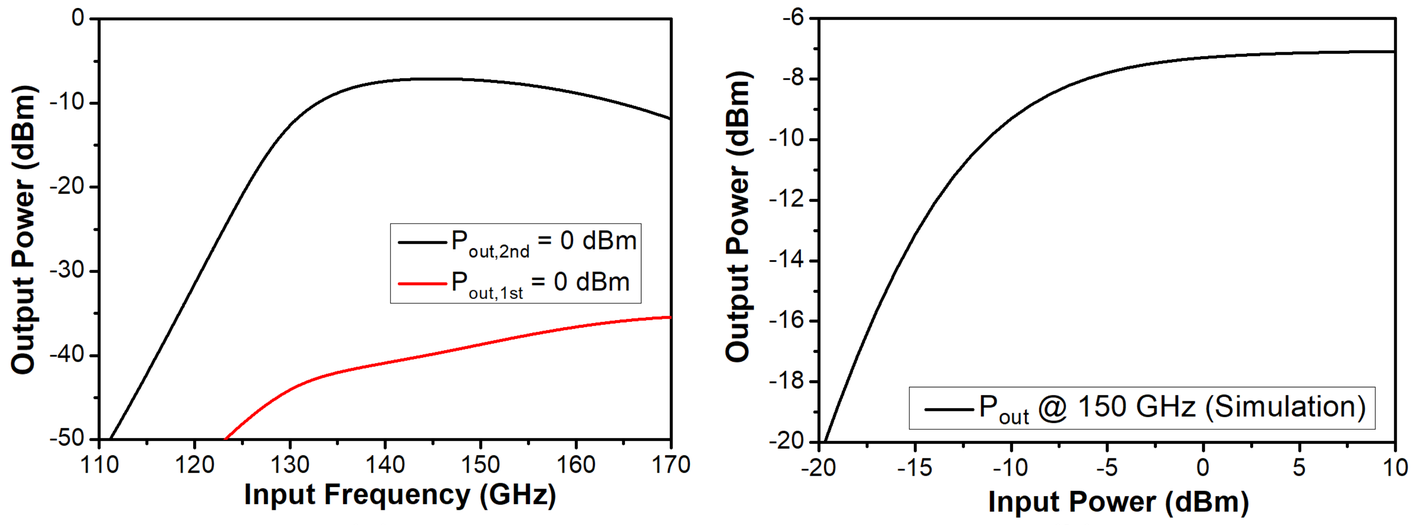


Fig. 3. Chip photo.



(a) (b)

Fig. 4. Simulation results of frequency doubler.

1. Circuit Design

- Fig. 1 shows the block diagram of the AFDC.
- Gilbert-cell base frequency doubler is adopted to implement differential output.
- Inductor (L1,L2) is implemented to improve gain and output power.
- A 4-stage common-source common-source amplifier with capacitive neutralization technique is adopted for the 150-GHz drive amplifier as show in Fig.2(b).
- The capacitive neutralization technique is adopted to improve stability and gain.

2. Simulation Result

- Fig. 3 shows the chip photo of the fabricated frequency doubler.
- The chip size is 679 × 864 μm^2 including pads.
- In Fig. 4 (a), the simulated peak output power is -7.2 dBm at 290.4 GHz with input power of 0 dBm. The 3-dB bandwidth with input power of 0 dBm is 64.4 GHz, ranging from 265.4 GHz to 329.8 GHz.
- In Fig. 4(b), the simulation exhibits the saturated output power of -7.3 dBm at 300 GHz with input power of 0 dBm.

Conclusion

A WR-3.4 band AFDC has been designed in this work based on 28-nm CMOS technology. It has peak output power of -7.2 dBm at 290.4 GHz with 0 dBm input power and saturated output power of -7.3 dBm at 300 GHz with input power of 0 dBm. This circuit will be measured with spectrum analyzer and power meter to evaluate output frequency and output power. The designed frequency doubler can be applied to WR-3.4 band LO signal generator for wireless communication or radar system.

Acknowledgement

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Reference

[1] J.-S. Rieh and SpringerLink, *Introduction to Terahertz Electronics*, 1st 2021. ed. Cham: Springer International Publishing : Imprint: Springer (in English), 2021.