



A 183–293-GHz Transformer-based Wideband Amplifier based on 250-nm InP HBT Technology

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Introduction

The terahertz (THz) band (>100 GHz) offers a wide range of applications including communications, radar, and imaging system thanks to its wide bandwidth capabilities. To realize high-frequency systems, a wideband amplifier serves as a crucial component. In this work, a amplifier with 3-dB bandwidth of 100 GHz is designed based on Teledyne 250-nm InP HBT technology.

1. Circuit Design

- Fig. 1. shows the schematics of proposed differential amplifier and its unit-cell.
- In Fig. 1(a), The amplifier consists of 6-stage common-emitter amplifiers. Series capacitors (C_1 , C_2) are utilized to enable two-frequency point matching at 190 GHz and 300 GHz.
- In Fig. 1(b), conjugate impedance matching was implemented with transformers and shunt cap (C_3 , C_4) to minimize the chip size and simplify the biasing network. Each unit cell is designed with feedback resistors (R_1 , R_2) for broadband stability [1].
- Fig. 2 shows the layout of the amplifier.
- By employing a differential topology that facilitates the virtual ground, the circuit can be made less sensitive to the ground route.

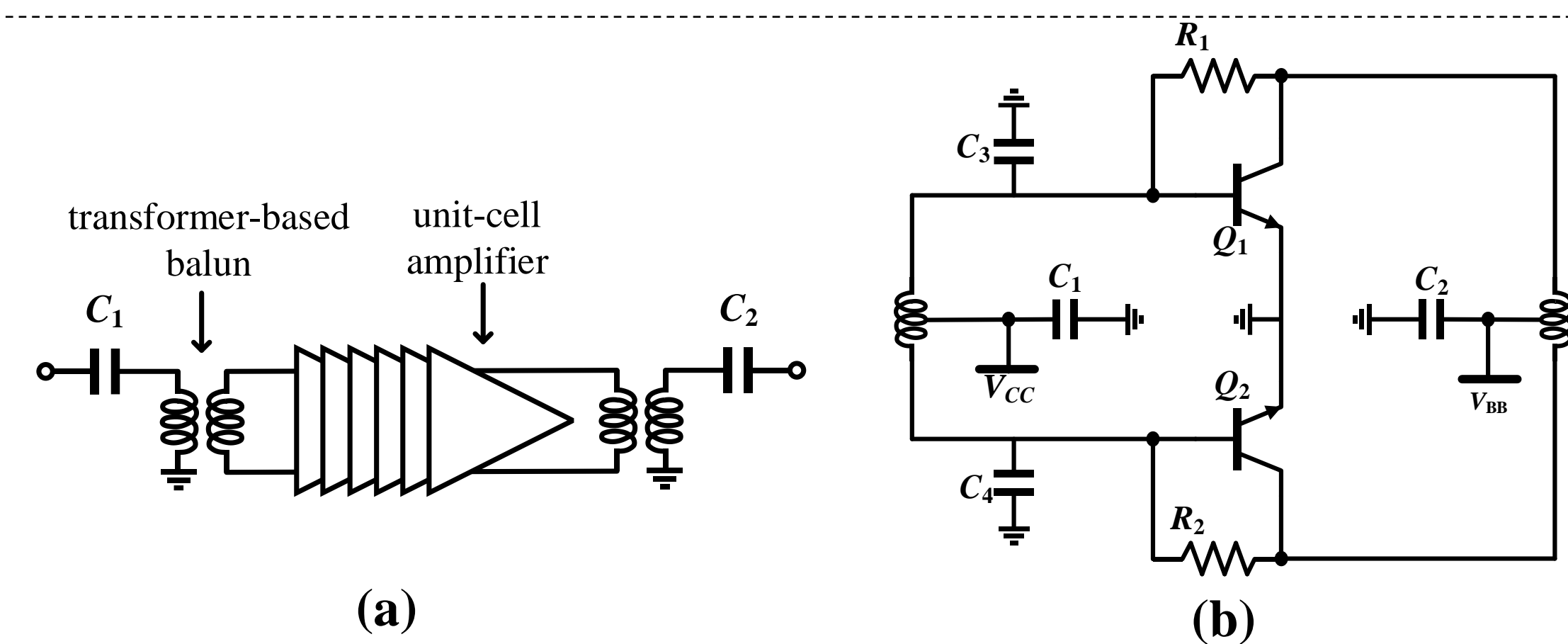


Fig. 1. Schematics of the amplifier (a), and the unit cell (b).

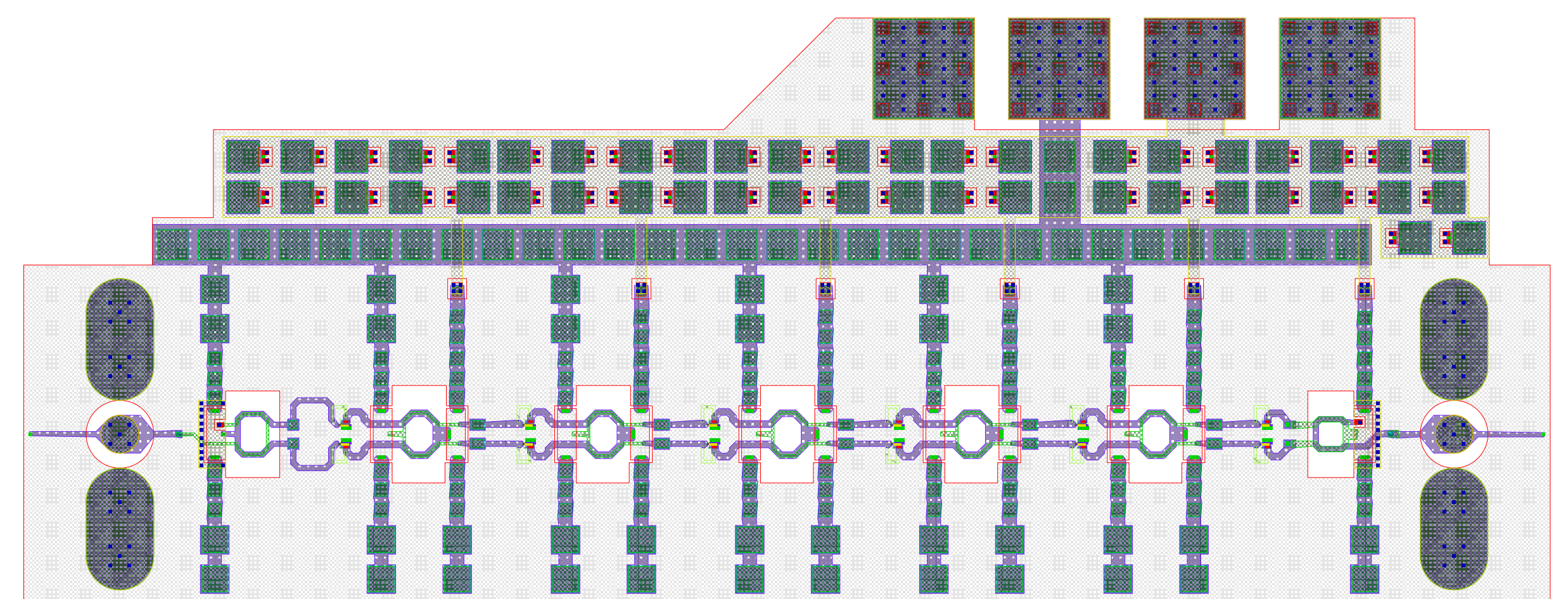


Fig. 2. Layout of the amplifier.

2. Simulation Result

- The simulated results of the amplifier are shown in Fig. 3.
- In Fig. 3(a), the peak small-signal gain is 12.5 dB at 194 GHz. The 3-dB bandwidth is 100 GHz, ranging from 183 GHz to 293 GHz.
- In Fig. 3(b), output power at 1-dB compression point is 0.48 dBm at 600 GHz with an input power of -6.80 dBm. The saturated output power is 5.69 dBm at 600 GHz with an input power of 7 dBm.
- The chip size is $1127 \times 433 \mu\text{m}^2$ including pads.

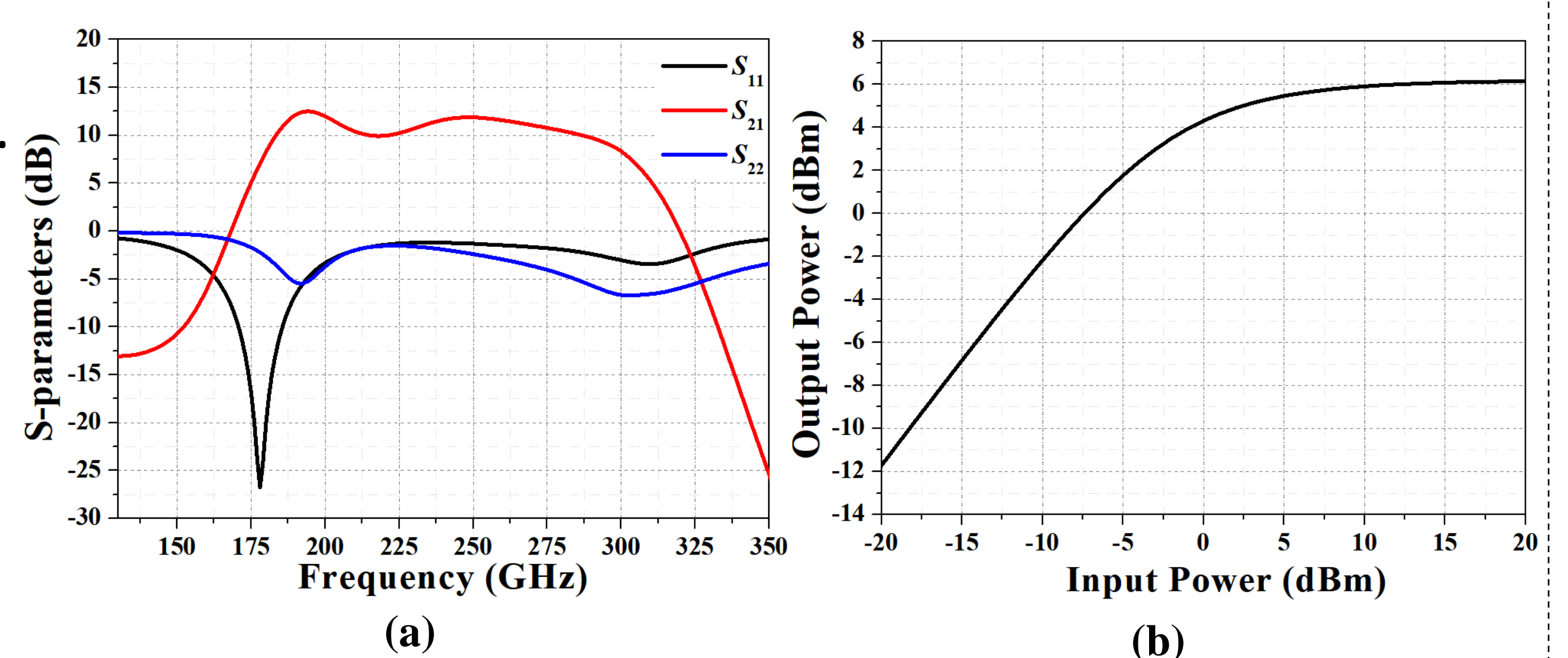


Fig. 3. Simulated S-parameters (a) and simulated output power versus input power (b).

Conclusion

In this work, A six-stage differential wideband amplifier with feedback resistors has been designed based on Teledyne 250-nm InP HBT technology. It has 12.5 dB peak small-signal gain at 194 GHz with 100-GHz 3-dB bandwidth. The designed amplifier can be applied to terahertz systems, including wireless communication, radar and imaging systems. Unfortunately, this circuit didn't work due to an open portion resulting from mistake during layout process. Therefore, it will undergo a revision through another HM process in the future.

Acknowledgement

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Reference

[1] H. J. Park, J. S. Rieh, M. Kim and J. B. Hacker, "300 GHz six-stage differential-mode amplifier," *2010 IEEE MTT-S International Microwave Symposium*, Anaheim, CA, USA, 2010, pp. 49-52, doi: 10.1109/MWSYM.2010.5518084..