IDEC Chip Design Contest

D-band Wideband Joint-Injection Mixer

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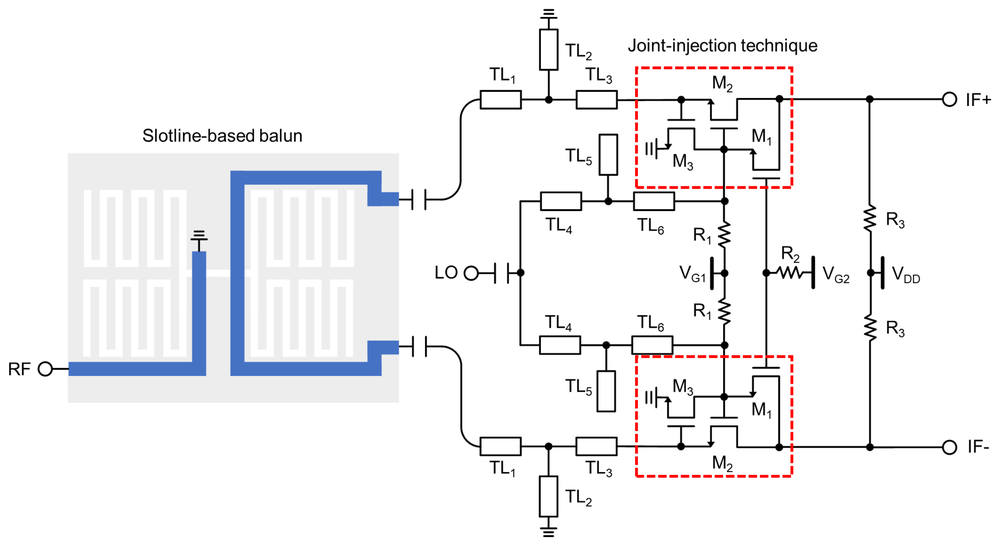
Introduction

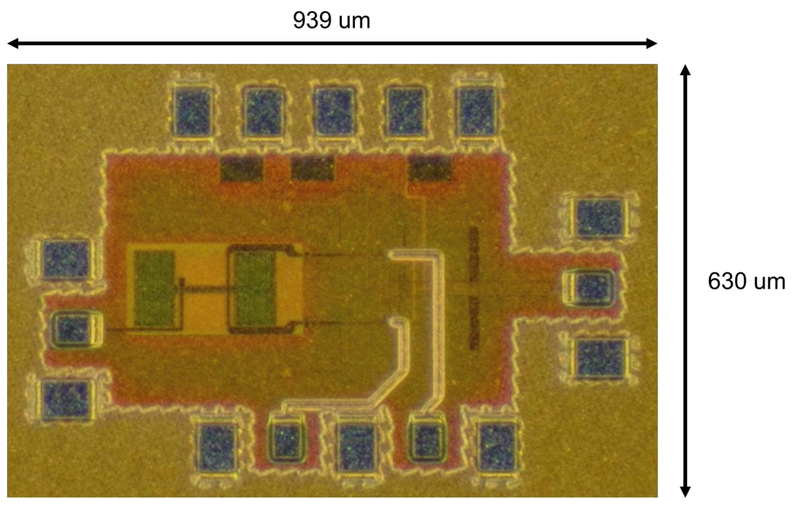
- **Motivations of the sub-THz spectrum**
  - Offers abundant bandwidth for ultra-high-speed wireless communications.
  - Suited for radar, imaging, and high-resolution sensing applications.
- **The necessity of wideband mixer**
  - A wideband mixer is essential to ensure that the down-conversion stage does not limit the overall receiver bandwidth.
  - It enables broad frequency coverage using a single receiver path with reduced hardware complexity.

Design

- Joint-injection technique lowers the effective gate input impedance of the conventional structure, thereby simplifying LO / RF matching and achieving broadband input matching.
- The slotline-based balun provides a balanced differential signal, thereby supporting wideband mixer operation with low amplitude and phase imbalance.
- Chip size : 0.939 x 0.63 mm^2 (0.59 mm^2)



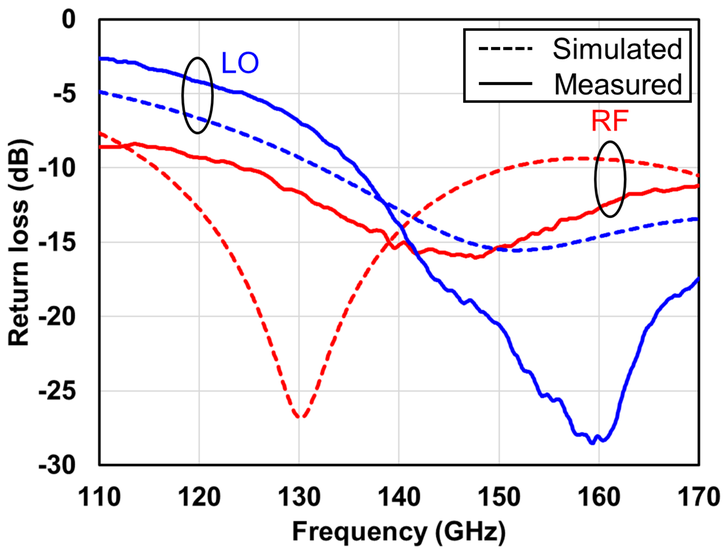
<Mixer schematic>

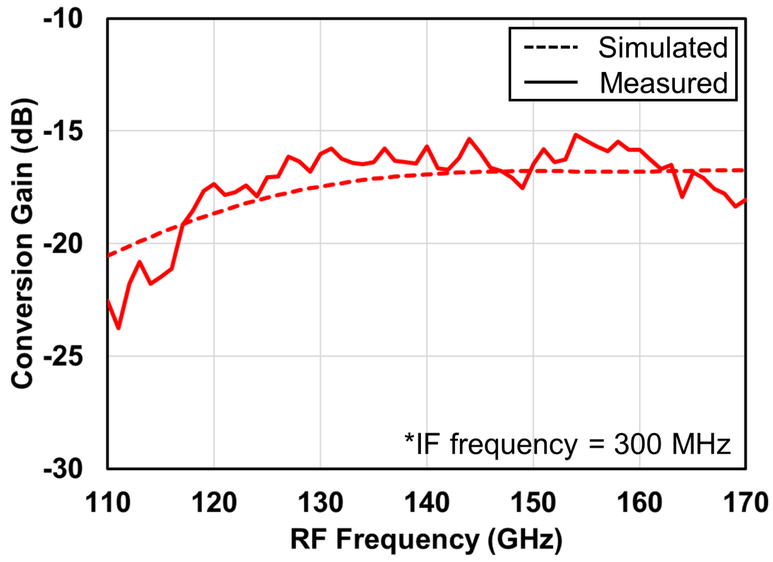


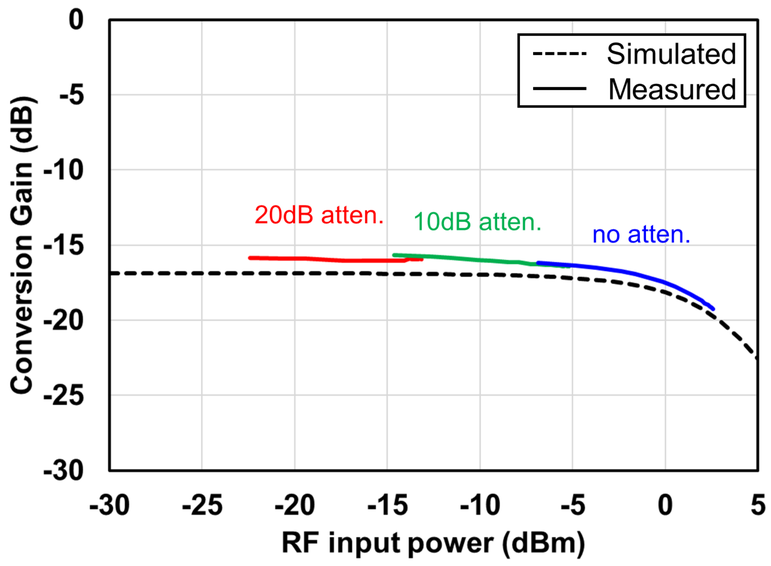
<Mixer chip micrograph>

Results

- **Input matching measurement**
  - RF return loss > 8 dB at 3-dB BW
  - LO return loss > 3 dB at 3-dB BW
- **Conversion-gain (CG) measurement**
  - Peak CG = -15.2 dB
  - 3-dB CG BW = 118 – 168 GHz
- **P_{1dB} measurement**
  - IP_{1dB} = -2.3 dBm at 140 GHz







Conclusion

- We have developed a wideband joint-injection mixer in a 28-nm CMOS process.
- With the IF frequency fixed at 300 MHz, the mixer exhibits a 3-dB conversion-gain bandwidth of 118 – 168 GHz.

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