Down-Conversion Mixer Using λ/4-TL-C-based Coupler and BSFB Technique for 28 GHz 5G NR
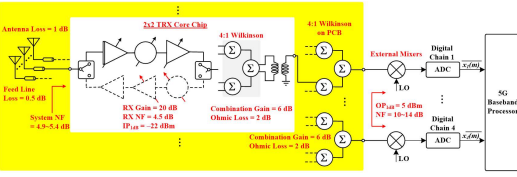
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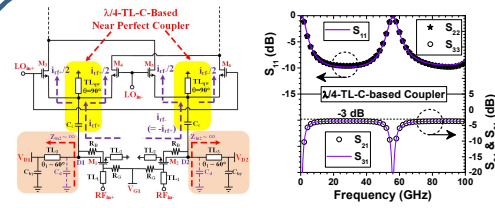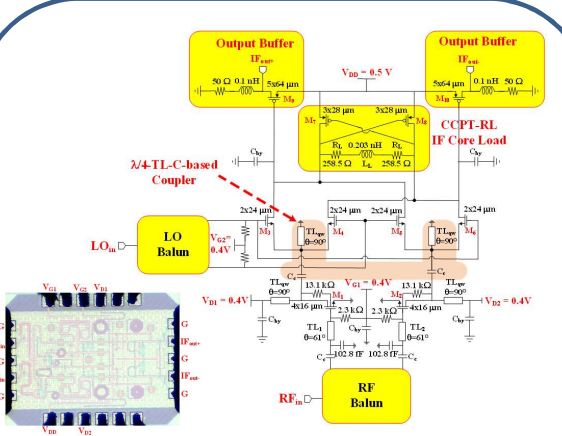## STATUS QUO

Down-Conversion Mixer for 28 GHz 5G NR

- ✓ Traditional down-conversion mixer is hard to achieve low V_{DD} and P_{DC}, wideband, and decent CG and NF at the same time
- ✓ λ/4-TL-and-C_c-based coupler and body-self-forward-bias (BSFB) technique are proposed

NEW INSIGHTS

Low V_{DD} and P_{DC}, high CG, and low NF operation

- ✓ λ/4-TL-C_c-based coupler
  - ➤ Low loss at operation band
  - ➤ Harmonics suppression
  - ➤ Low V_{DD} and optimized NF/gain/linearity design

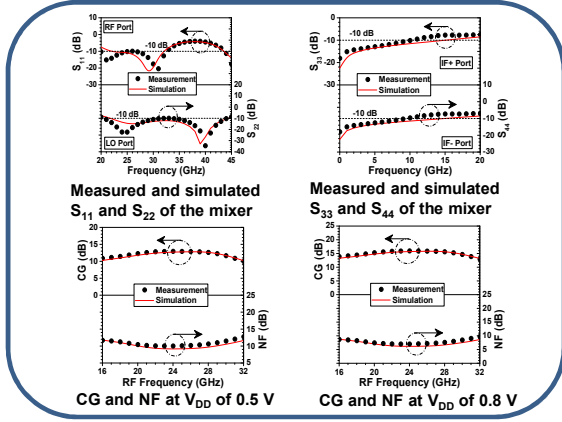## DESCRIPTION

The down-conversion mixer is composed of three parts:

- ✓ Double-Balanced Gilbert-Cell-based Mixer Core
  - ➤ RF gm-stage using the BSFB technique and a λ/4-TL-C-based coupler
  - ➤ The merits are straightforward design and layout, and harmonics suppression
  - ➤ CCPT-RL-based core IF load is used
- ✓ Wilkinson-Power-Divider-based Balun
  - ➤ Used as the required RF- and LO-balun
  - ➤ Decent AI and PD performance are achieved
- ✓ PMOS Output Buffer
  - ➤ PMOS CS Amplifier with LR load is used

QUANTITATIVE IMPACT

Measured and simulated S_{11} and S_{22} of the mixer

Measured and simulated S_{33} and S_{44} of the mixer

CG and NF at V_{DD} of 0.5 V

CG and NF at V_{DD} of 0.8 V

PROPOSED CONCEPT GOALS

MM-wave down-conversion mixer featuring:

- ✓ Low V_{DD} (0.5-V) and P_D (4.5-mW), high CG (12.6-dB), wideband (12.4-32-GHz), and low NF (10.6-dB)
- ✓ λ/4-TL-C-based coupler is used for near perfect coupling & harmonics suppression
- ✓ BSFB technique is used for V_{th} and V_{DD} reduction & substrate leakage suppression
- ✓ CG and NF enhancement at the same P_{DC} is achieved due to lower V_{DD} & higher g_m