CMOS Device Modeling for Millimeter-Wave Power Amplifiers

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Conclusion

- The simulation results of the 1-stage PA and 4-stage PA are corresponded with the measurement results.
- Measurement results of the 4-stage PA: Gain 20.5 [dB], P1dB 9.9 [dBm]

1. Background

60GHz band
A wide band can be used by unlicensed.
Using for the high-speed wireless communications in the short distance.

2. Approach to 60GHz CMOS robustness design

- Matching by transmission line
- In-house PDK based on measurement
- Tile-base layout

3. Transmission line model

- Guided Micro-Strip Line was used for the transmission line.
- The model was made as α, β, Q value, and characteristic impedance Z0 showed that the characteristic of the transmission line were corresponding.

4. T-junction model

T-junction model is made from the measurement result. Capacitance is added to the transmission line model.

5. Decoupling capacitor model

- Model at low frequency
  - Planar unit
  - Model as lumped parameter
- Model at millimeter waveband
  - Interdigital type
  - L and C are distributed and the resonance frequency is improved.
  - Model as transmission line

6. 1-stage PA

To verify the accuracy of the models, a 1-stage PA is fabricated by using the modeled transistor and transmission line.

7. 4-stage PA

- The measurement results and the simulation result almost agree with each other.
- Measurement results of the 4-stage PA: Gain 20.5 [dB], P1dB 9.9 [dBm]