1 Background

On-wafer measurement needs contact pads

- Measurement data includes the device under test (DUT) and the pad parasitic components.
- At millimeter wave (MMW), parasitic components are not negligible.

2 Conventional de-embedding method

- Open-short de-embedding method

  - Difficult to get the ideal patterns at high frequency (MMW)
  - The through-line is required to be very short
  - Probe coupling

- Thru-only de-embedding method

  - The thru-only de-embedding method is difficult to get the ideal patterns at high frequency (MMW)
  - The through-line is required to be very short
  - Probe coupling

3 Proposed de-embedding method

- Two transmission lines

  - Based on distributed-constant approach
  - Doesn’t need “Short” or “Short-Line”

  \[ Y_{\text{shunt}} = \frac{Y_{\text{pad}}(1,1) + Y_{\text{pad}}(2,1) + Y_{\text{pad}}(1,2) + Y_{\text{pad}}(2,2)}{2} \]

  - Shunt Impedance

4 Results and Conclusion

- De-embedding of different-length TLs (200µm and 400µm)
- Compare \( Z_0 \), \( \alpha \), \( \beta \)

  - Mismatched in \( Z_0 \) when using open-short
  - Thru-only gives a large difference in \( \alpha \)
  - Up to 80GHz, the error in \( Z_0 \), \( \alpha \), \( \beta \) is less than 5.5%, 2%, and 3% respectively by using the proposed method.

Device Measurement

- Contact Pads

  - De-Embedding

  - Remove parasitic components from measurement data

Parasitics of pad

De-embedding process

Chip photo

- Thru-only

  - Mismatched in \( Z_0 \) when using open-short
  - Thru-only gives a large difference in \( \alpha \)

  - Up to 80GHz, the error in \( Z_0 \), \( \alpha \), \( \beta \) is less than 5.5%, 2%, and 3% respectively by using the proposed method.