Determination of S-parameters in the 200-300 GHz range

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Outline

• Introduction
• Motivation
• Passive test structure
• Short-Open-Load-thru
• Meas. Vs Simu.
• Meas. Vs Sim. (dembeded)
Introduction

• Availability of silicon technologies with $F_t/F_{\text{max}}$ of 300/500 GHz
• 200~300 GHz frequencies becoming hot in Research
• The main applications of millimeter-wave systems
  – Imaging [1]
  – Ultra fast communication [2]
  – Spectroscopy [3]

[1] http://eyegillian.wordpress.com/2008/03/10/from-x-rays-to-t-rays
Motivation

• As a designer
  – Accurate S-parameters representation of the HBT
  – Model to hardware correlation
  – Accurate input and output impedance

• 220-320 GHz VNA is available
  – Develop calibration structure for HBT
Passive test structure

- Transmission lines with different characteristic impedance
- Measure the different S-parameters
- The tan(d) of the dielectric is changed
  - To fit the simulation and the measurements

Before fitting

After fitting

Cross Section

Top Metal 2

Metal 1

3 um

9.8 um
Passive test structure
Short-Open-Load-thru

• Test structures for:
  – Short
  – Open
  – Load
  – Through

• Will be used to compare the EM simulation and the measurements

• Develop a simple Dembedding technique in ADS
Short

- Microstrip lines (50 Ω)
- Via array short to gnd
- 230 μm each side
Open

- Microstrip lines (50 Ω)
- 230 μm each side
- Open ends before HBT contacts
Load

- Microstrip lines loaded with 50 Ω resistors
- The resistors are connected on the HBT interface
- The parasitic capacitances of the resistors are included
Through

freq, GHz

freq (220.0GHz to 320.0GHz)
HBT with Input output lines

- HBT test structure is measured 220-320 GHz
- EM simulation of the lines and HBT VBIC and HICUM modeless are used

2 dB difference
HICUM & VBIC almost identical
• use Dembedding in ADS to remove the effect of half of the connections
• Compare with model simulation

Meas. Vs Sim. (dembedded)
THANKS

Q&A