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

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Outline

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

Introduction

- Availability of silicon technologies with F_t/F_{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]

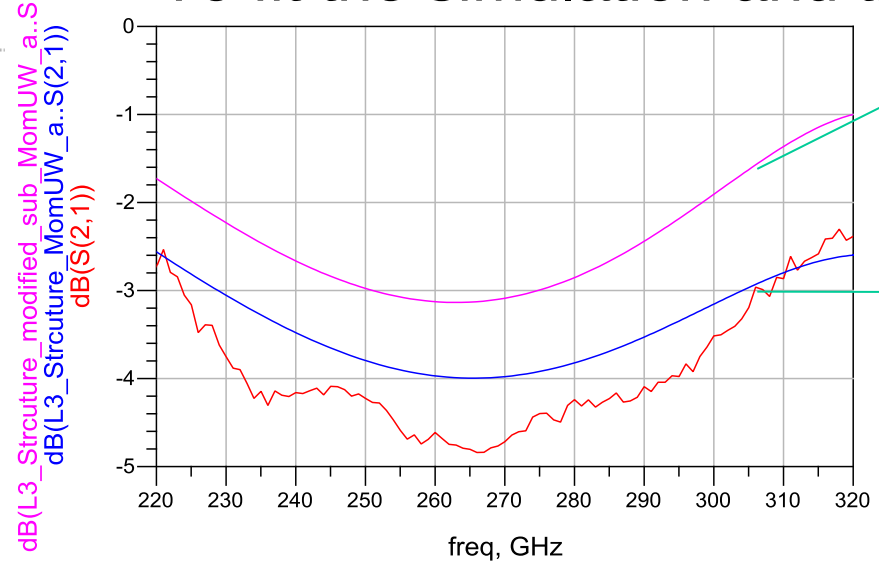
[1] http://eyegillian.wordpress.com/2008/03/10/from-x-rays-to-t-rays
[2] http://www.ieee802.org/15/pub/IGthz.html
[3] www.ntt-review.jp/archive/ntttechnical.php?contents=ntr200903sf6.pdf&mode=show_pdf

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

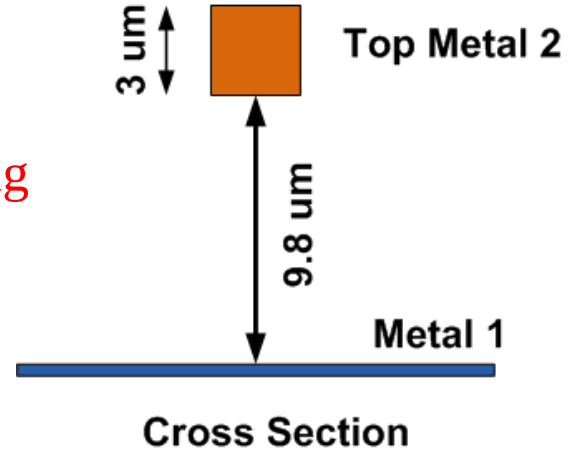
Passive test structure

- 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

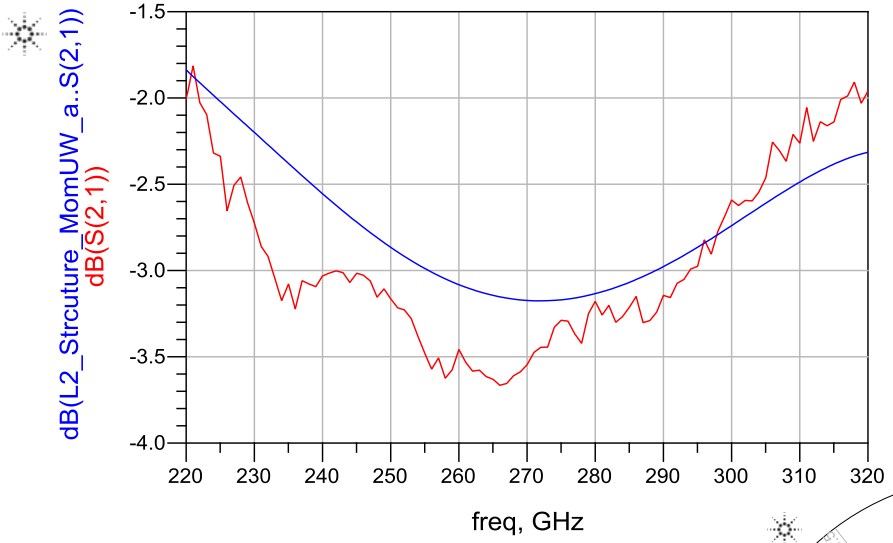


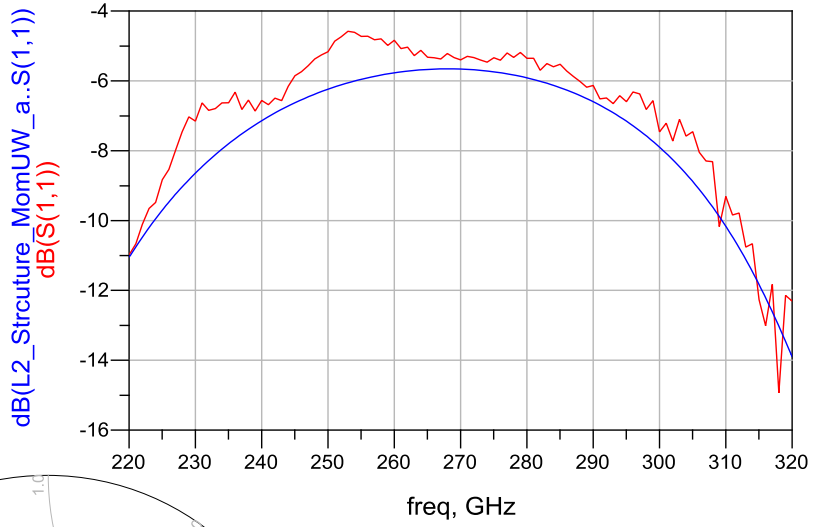
Before fitting

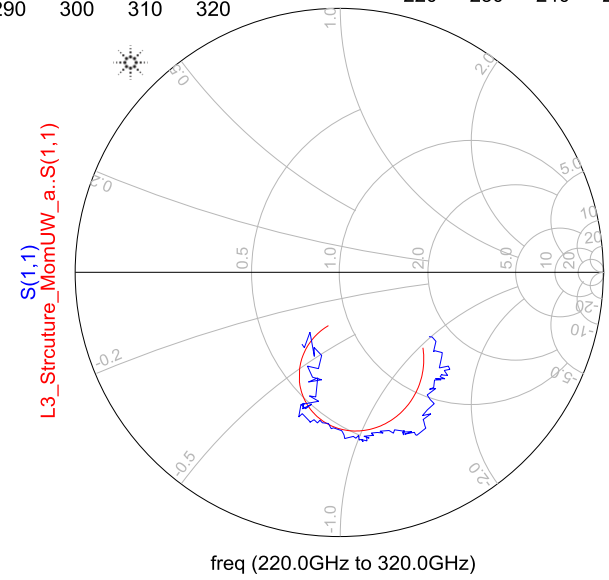
After fitting



Passive test structure





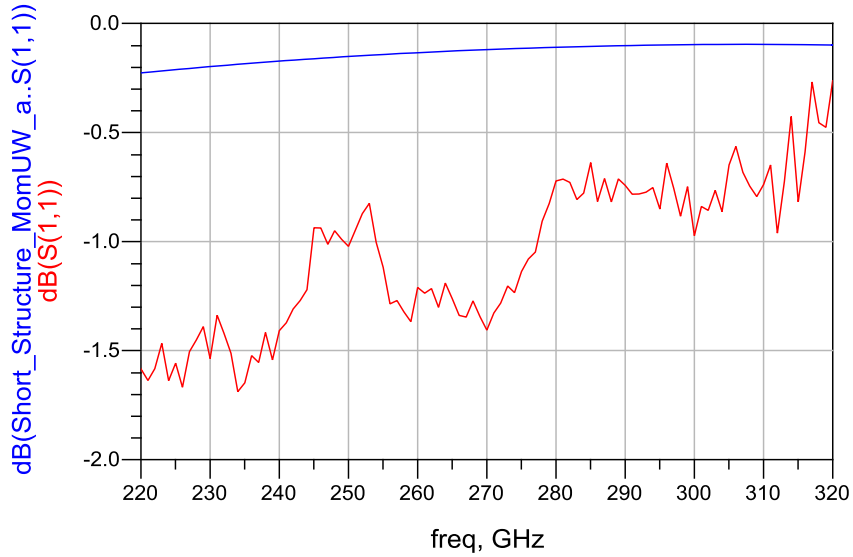


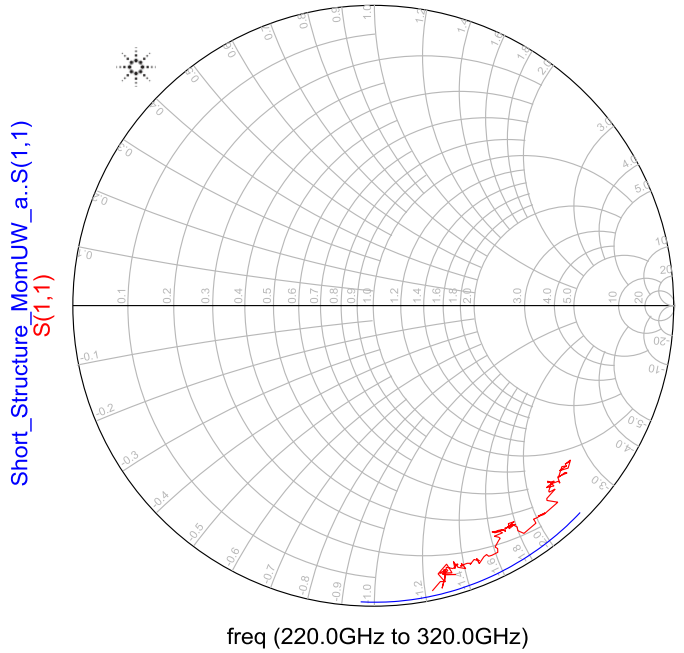
Short-Open-Load-thru

- 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

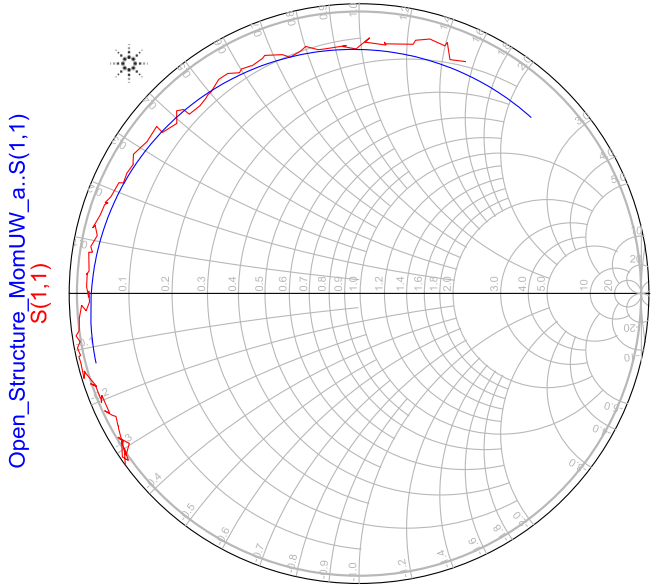
- Microstrip lines (50 Ω)
- Via array short to gnd
- 230 µm each side

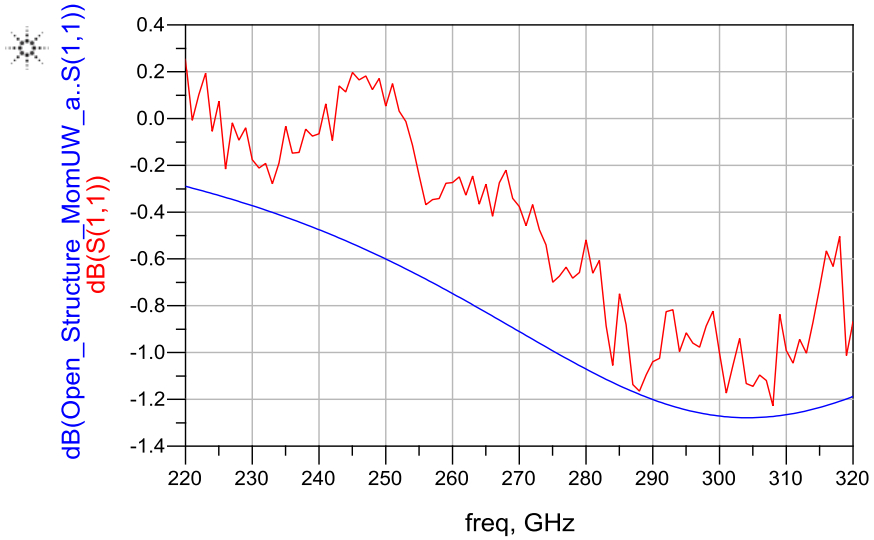




Open

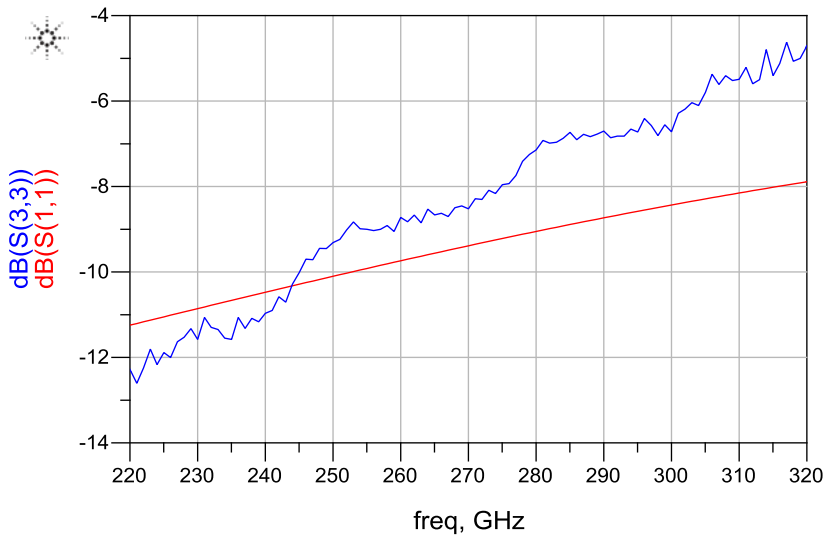
- Microstrip lines (50 Ω)
- 230 µm each side
- Open ends before HBT contacts

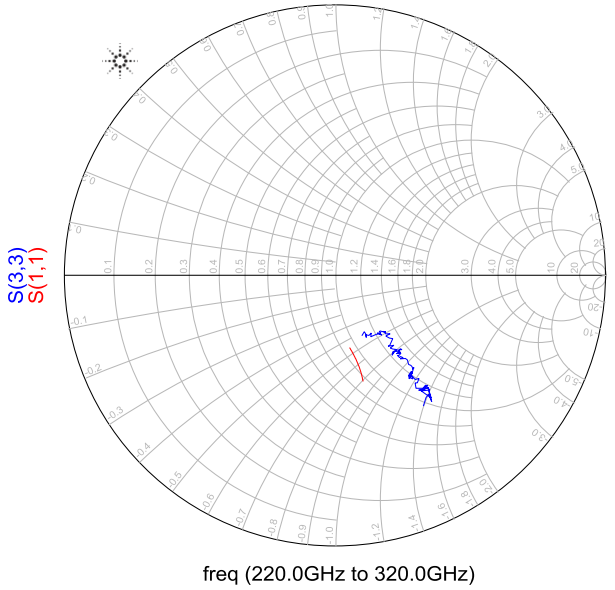




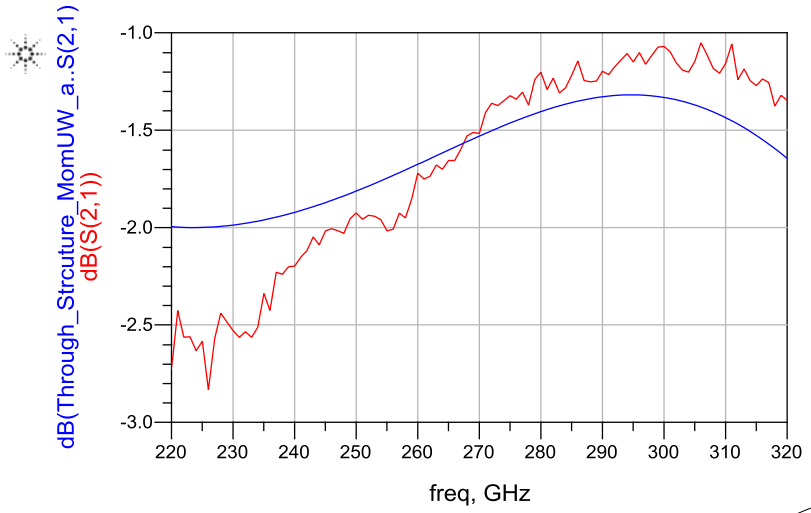
Load

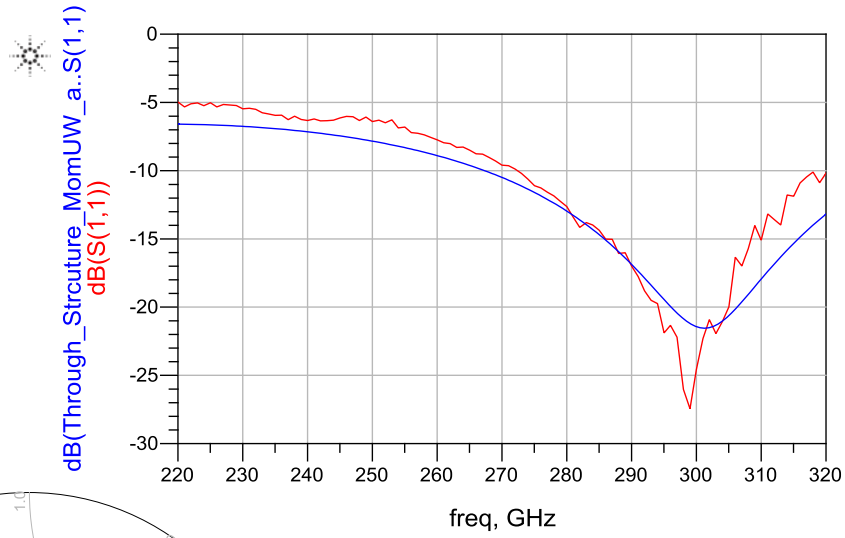
- Microstrip lines loaded with 50 Ω resistors
- The resistors are connected on the HBT interface
- The parasitic capacitances of the resistors are included

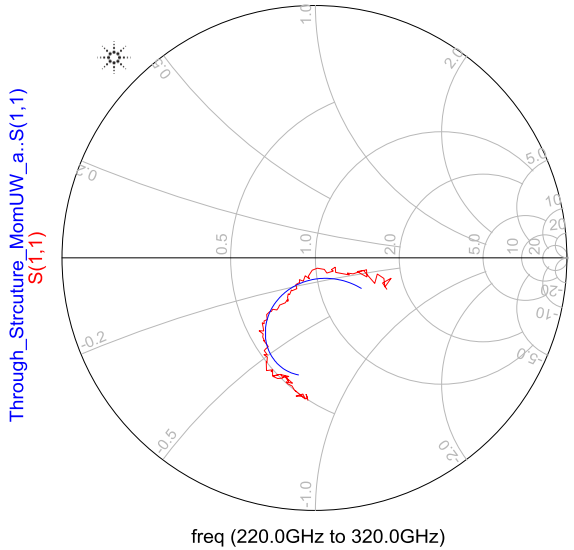




Through

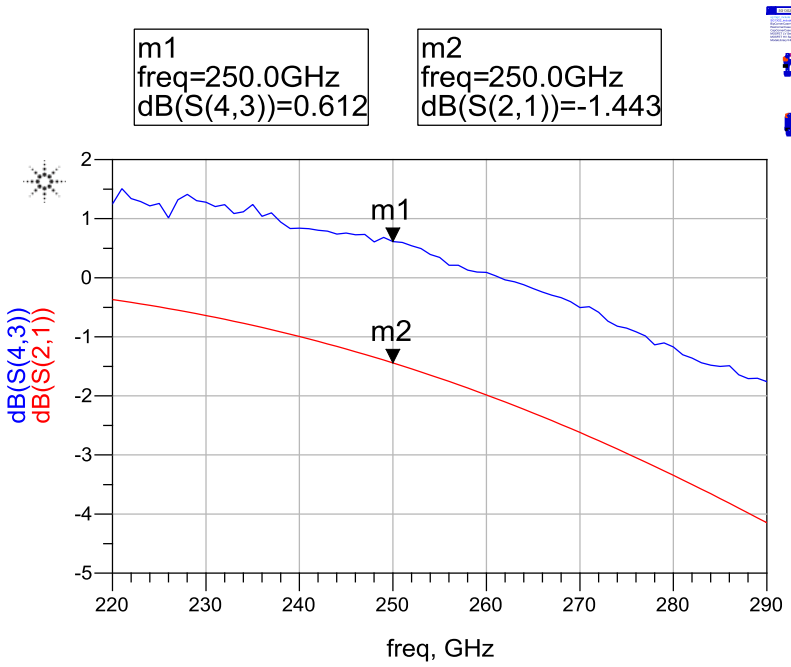

dB(Through_Strcuture_MomUW_a..S(2,1))
dB(S(2,1))
-1.0
-1.5
-2.0
-2.5
-3.0
220
230
240
250
260
270
280
290
300
310
320
freq, GHz

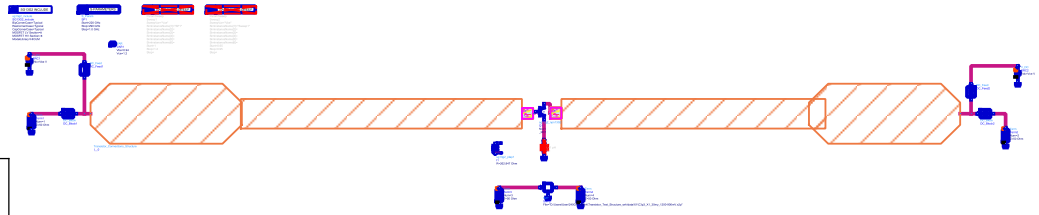

dB(Through_Strcuture_MomUW_a..S(1,1))
dB(S(1,1))
0
-5
-10
-15
-20
-25
-30
220
230
240
250
260
270
280
290
300
310
320
freq, GHz


Through_Strcuture_MomUW_a..S(1,1)
S(1,1)
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

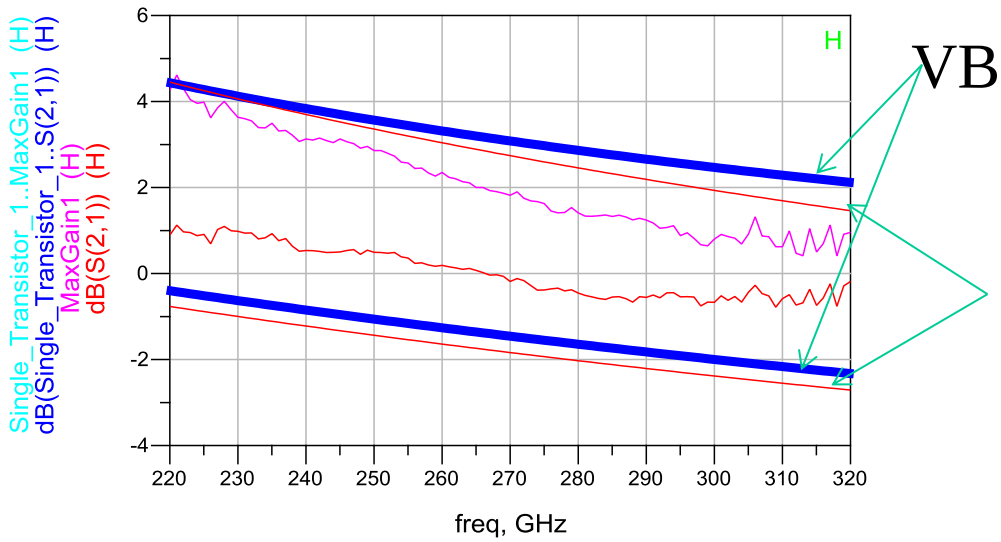




2 dB difference
HICUM & VBIC almost identical

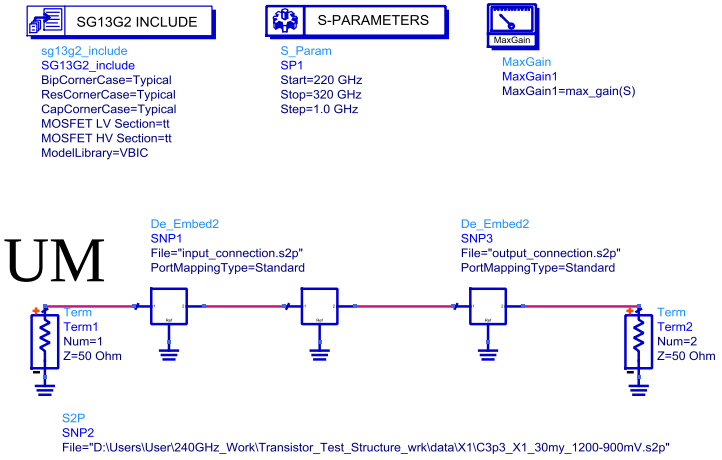
Meas. Vs Sim. (dembeded)

- use Dembedding in ADS to remove the effect of half of the connections
- Compare with model simulation



VBIC

HICUM



THANKS
Q&A