Using WaferPro Express with B2200A Switch Matrix

Raj Sodhi
Keysight EEsol EDA
Device Modeling Product Marketing
Different Types of Measurements

DC IV or DC CV Measurements
- Majority of foundries use these measurements for baseband modeling
- Typically 4-5 systems in a lab

DC IV + RF S-parameter Measurements
- For high-frequency modeling
- Typically 1 system in a silicon foundry lab
- For GaAs foundry, main application focus is RF
E5270B Precision IV Analyzer / 8 Slot Precision Measurement Mainframe

Applying or measure current or voltage to devices under test

B2200A fA Leakage Switch Mainframe

Reuse hardware to visit many sites
- in multi-pin package
- on probe card
Switch matrix applications

Switch Matrix

Probe Card
or...

Packaged Group
of Parts

DC-IV
Capacitance

ports

pins
Hardware Setup

Package Test ET

E5270B

B2200A

48 triax connections
Package Test ET

48 triax connector board mated to 24 pin socket

Force and sense connect just before socket

Guard = open
Packaged Device Measurements

High-power SMU1

Medium-power SMU3

High-power SMU2

Medium-power SMU4
WaferPro Express GPIB Connections

Hardware Connections

1. GPIB Interface
2. Active Instruments
3. System Hardware
4. System Hardware Settings
5. Connection Test

System Hardware Settings:
- Interface: gpyb0
- Address: 2

Active Instruments:
- Keysight N2220A (gpyb0, 5)

System Hardware:
- Probes
  - Matrix
  - Chucks

Connection Test:
- GPIB Connection: AGILENT.E22209A.0.0.01.04
- Test: AGILENT.E22209A.0.0.01.04

Options:
- Initialize Setup
- Ground All
- Disconnect All

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Packaged Device Measurements
Page 8
Force
Sense

{WPE_Home}\hpeesof\waferpro_2016_04\instr\B2200A_02.matrix
Where to look at Switch Matrix drivers
... and define your own!

In C:\Keysight\WAFTERPROXP_2016_04_HF1\waferpro\config\DriverLibs

Driver~Matrix~B2200A.set
Driver~Matrix~B2200A_01.set

For set V only, standard approach
For force and sense (Kelvin Connection)

If you make a copy of this to edit it and call it B2200A_02, it will be saved here:
{WPE_Home}\hpeesof\waferpro_2016_04\config\DriverLibs

Now it shows up here:
let's look at the switch matrix driver
Sets the number of pins separation between force and sense
8 HBT devices bonded out to different pins

Collector = Package Ground
Base to pin
Emitter to pin
(no ESD wire)
Routine vs Measurement Group

Routine:
- Measurement Setup
- Routine Control Variables (RCV)

Measurement Groups:
- Sets of RCV’s

Low Bias – small device
- Vemitter = -1.5 V
- Ibase = 1 uA

Medium Bias – medium device
- Vemitter = -2.5 V
- Ibase = 10 uA

High Bias – big device
- Vemitter = -3.5 V
- Ibase = 100 uA

a measurement group instantiates your routine with particular bias conditions
Factory Provided Biasing Scheme
BJT/DC/Wpro_BJT_DC/Output
Assumes 4 Terminals

Desired Biasing Scheme
3 Terminals
Lets create a new type of device:
BJT_3T
device types:
- BJT
- MOSFET
- HEMT

measurement types:
- WPro_MOSFET_DC
- WPro_MOSFET_DC_basic
- WPro_MOSFET_DC_basic2
- WPro_MOSFET_DC_basic2_py
- WPro_MOSFET_DC_basic3
- WPro_MOSFET_DC_basic_py

routines (factory defined):
- new device

packaged device measurements
Let’s create a routine for our new device that makes sense for a 3 port device.

Add a new measurement type
Choose “DC”

Copy a routine from factory provided BJT routines

paste it into BJT_3T/DC

now customize this routine
Routine Control Variables

<table>
<thead>
<tr>
<th>Name</th>
<th>Default Value</th>
<th>Unit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Name</td>
<td>(MC2)</td>
<td></td>
<td>Measurement Condition Name (used by the system)</td>
</tr>
<tr>
<td>2. ComplI</td>
<td>5m</td>
<td>A</td>
<td>Current Compliance</td>
</tr>
<tr>
<td>3. ComplV</td>
<td>1.5</td>
<td>V</td>
<td>Voltage Compliance</td>
</tr>
<tr>
<td>4. Gummel MNL</td>
<td>CE</td>
<td></td>
<td>Measurement Node List for Gummel measurement</td>
</tr>
<tr>
<td>5. Ib_Start</td>
<td>0.1u</td>
<td>A</td>
<td>Base current bias start value</td>
</tr>
<tr>
<td>6. Ib_Stop</td>
<td>100u</td>
<td>A</td>
<td>Base current bias stop value</td>
</tr>
<tr>
<td>7. Ib_Step</td>
<td>10u</td>
<td>A</td>
<td>Base current bias step value</td>
</tr>
<tr>
<td>8. VCE</td>
<td>0</td>
<td>V</td>
<td>Collector to Base bias</td>
</tr>
<tr>
<td>9. Output_MNL</td>
<td>CE_F</td>
<td></td>
<td>Measurement Node List for Output Characteristics measurement</td>
</tr>
<tr>
<td>10. Vce_Norm</td>
<td>1.5</td>
<td>V</td>
<td>For Gummel plot</td>
</tr>
<tr>
<td>11. Vce_Start</td>
<td>0</td>
<td>V</td>
<td>Collector to Emitter bias start value</td>
</tr>
<tr>
<td>12. Vce_Stop</td>
<td>2</td>
<td>V</td>
<td>Collector to Emitter bias step value</td>
</tr>
<tr>
<td>13. Vce_Step</td>
<td>0.05</td>
<td>V</td>
<td>Collector to Emitter bias step value</td>
</tr>
</tbody>
</table>

These are just variable names, with default values and descriptions.
Set voltages, measure currents, etc.

**What biases do we apply to each port?**

<table>
<thead>
<tr>
<th>Name</th>
<th>Mode</th>
<th>Unit</th>
<th>Node1</th>
<th>Node2</th>
<th>SweepType</th>
<th>SweepOrder</th>
<th>Compliance</th>
<th>Value/Sweep Setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>vc</td>
<td>V</td>
<td>SMUL C</td>
<td>GROUND</td>
<td>LIN</td>
<td>CON</td>
<td>-</td>
<td>Compl.1</td>
<td>Value: 0.000</td>
</tr>
<tr>
<td>ib</td>
<td>I</td>
<td>SMUL B</td>
<td>GROUND</td>
<td>LOG</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**What do we want to measure and at what port?**

<table>
<thead>
<tr>
<th>Name</th>
<th>Mode</th>
<th>Unit</th>
<th>Node1/Part1</th>
<th>Node2/Part2</th>
</tr>
</thead>
<tbody>
<tr>
<td>ib</td>
<td>I</td>
<td>SMUL B</td>
<td>GROUND</td>
<td></td>
</tr>
<tr>
<td>ic</td>
<td>I</td>
<td>SMUL C</td>
<td>GROUND</td>
<td></td>
</tr>
<tr>
<td>ie</td>
<td>I</td>
<td>SMUL B</td>
<td>GROUND</td>
<td></td>
</tr>
</tbody>
</table>

**What do we want to plot?**
What do we want to plot?

![Plot Editor](image1)

![MultiPlot](image2)
Routine vs Measurement Group - Revisited

Routine:
- Measurement Setup
- Routine Control Variables (RCV)

Measurement Groups:
- Sets of RCV’s

Low Bias – small device
Medium Bias – medium device
High Bias – big device

a measurement group instantiates your routine with particular bias conditions
Measurement Group

... instantiates a routine with specific variable settings

Only valid for Device “BJT_3T”

Points to our newly created routine “BJT_DC”

Measurement Group name = “BJT_3T_DC”

... will be called out in the test plan.
either run manual measurement on a single device or sequence the entire test plan.
Force Pin = 2*Package Pin – 1

Sense Pin = Force Pin + Offset
(where Offset = 1)
Measurement Log

Packaged Device Measurements

double-click any one of these to get all of the plots for that device
Where to Learn More
Keysight.com, Videos, Knowledge Center, etc.

WaferPro Express
Knowledge Center

For questions, call:
Keysight Support
+1 800 829-4444