IBIS and Power Delivery Systems

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Content

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1. IBIS history in Huawei

➢A accurate Simulate Model is first element of successful SI , and the difficult step.

- **1999 SI dept. founded**
- **2000 Test board and simulate arithmetic study**
- **2001 Mr. Bob Ross visit Huawei and lecture;IBIS Membership**
- **2001 Modeling Group foundedTrack Industry Model development**
- **2003 Ibischk4 fund**
- **Now Asian IBIS Summit 2005**

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2. Model Platform in Huawei

➢Total simulation Model solution

- **Model Platform**
  - **IBIS Model**
    - ADS/SQ/HSPICE
  - **HSPICE Model**
    - HSPICE
  - **Cap&Ind&S Model**
    - ADS/SQ/HSPICE

3. IBIS Validation

➢ Ibischk3

- ◆Syntax Errors and Warnings
- ◆Common Errors and Warnings
- ◆Structural Errors and Warnings
- ◆Non-monotonicity Warnings
- ◆Extraction Errors and Warnings

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3. IBIS Validation

➢IBIS file check(correct&Completeness,Databook)

◆**IBIS Properties**

◆**Component Properties** **[pin]list**

◆**Package&pin Properties**

- **C_pin L_pin R_pin ;**

◆**Model_type**

- **C_comp**
- **[Voltage Range]**
- **Vinh,Vinl**
- **Vmeas Vref Rref Cref**
- **Max/Min Data condition**
- **VI Properties**
- **VT Properties**

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3. IBIS Validation

- Simulate
  - Spice Correlation
  - Voltage Swings[high/low,over]
  - Timing Test Load Response
- Measure

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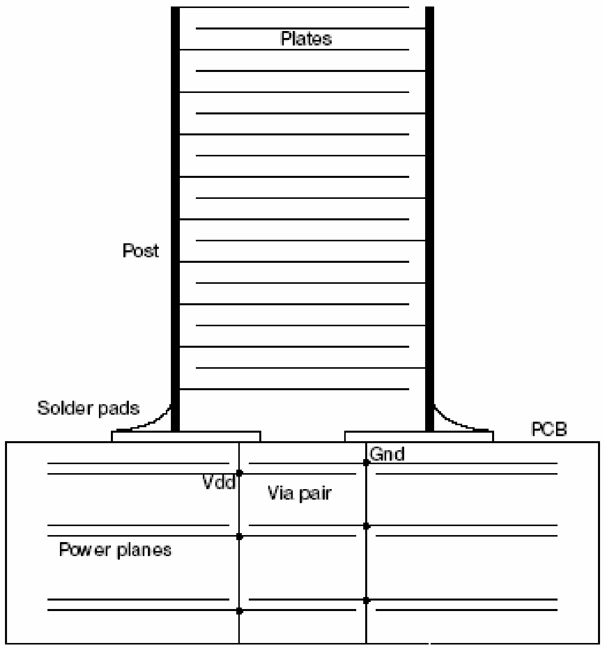
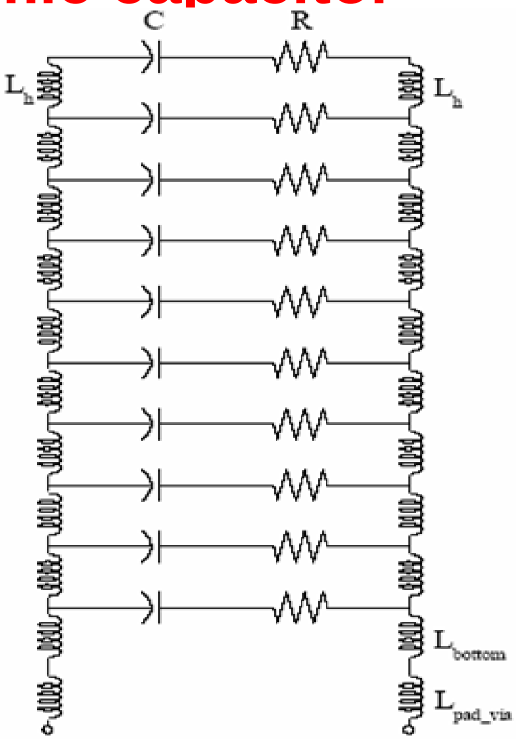
4.Huawei spice circuit model library of capacitor(PI)

➢Distributed circuit model of ceramic capacitor



Cross section of discrete capacitor mounted on PCB power planes



Distributed circuit model for SPICE derived from construction of ceramic capacitor

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4. Huawei spice circuit model library of capacitor(PI)

- **Element values model was extracted from measured s-parameter based on Monte Carlo method**

The spice netlist of 0.01uF ceramic capacitor

```
.subckt C_08070247 1 5
+ esr=1m loopInductance=1n
lloop 1 2 loopInductance
L11  2         3a     4.241151e-010 h
C11  3a        32a    8.785720e-010 f
R11  32a          4a          7.684703e-001 ohm
Lr1  4a        3      4.241151e-010 h
L12  3a        5a      1.439540e-011 h
C2   5a           31a          8.785720e-010 f
R2   31a       6a      7.684703e-001 ohm
Lr2  6a        4a      1.439540e-011 h
L13  5a        7a     1.439540e-011 h
C3   7a        30a    8.785720e-010 f
R3   30a       8a     7.684703e-001 ohm
Lr3  8a        6a     1.439540e-011 h
L14  7a        9a         1.439540e-011 h
C4   9a        29a    8.785720e-010 f
R4   29a       10a    7.684703e-001 ohm
Lr4  10a       8a     1.439540e-011 h
L15  9a        11a    1.439540e-011 h
C5   11a       28a    8.785720e-010 f
R5   28a       12a    7.684703e-001 ohm
Lr5  12a       10a    1.439540e-011 h
L16  11a       13a    1.439540e-011 h
C6   13a       27a    8.785720e-010 f
R6   27a       14a    7.684703e-001 ohm
Lr6  14a       12a    1.439540e-011 h
L17  13a       15a    1.439540e-011 h
C7   15a       26a    8.785720e-010 f
R7   26a       16a    7.684703e-001 ohm
Lr7  16a       14a    1.439540e-011 h
L18  15a       17a    1.439540e-011 h
C8   17a       25a    8.785720e-010 f
R8   25a       18a    7.684703e-001 ohm
Lr8  18a       16a    1.439540e-011 h
L19  17a       19a    1.439540e-011 h
C9   19a       24a    8.785720e-010 f
R9   24a       20a    7.684703e-001 ohm
Lr9  20a       18a    1.439540e-011 h
L110 19a       21a    1.439540e-011 h
C10  21a       23a    8.785720e-010 f
R10  23a       22a    7.684703e-001 ohm
Lr10 22a       20a    1.439540e-011 h
rl 3 4 esr //  esr in ohms
rdum 2 3 10Meg //  resistor to make dc path
vsense 4 5 0 ac=0
.ends C_08070247
```

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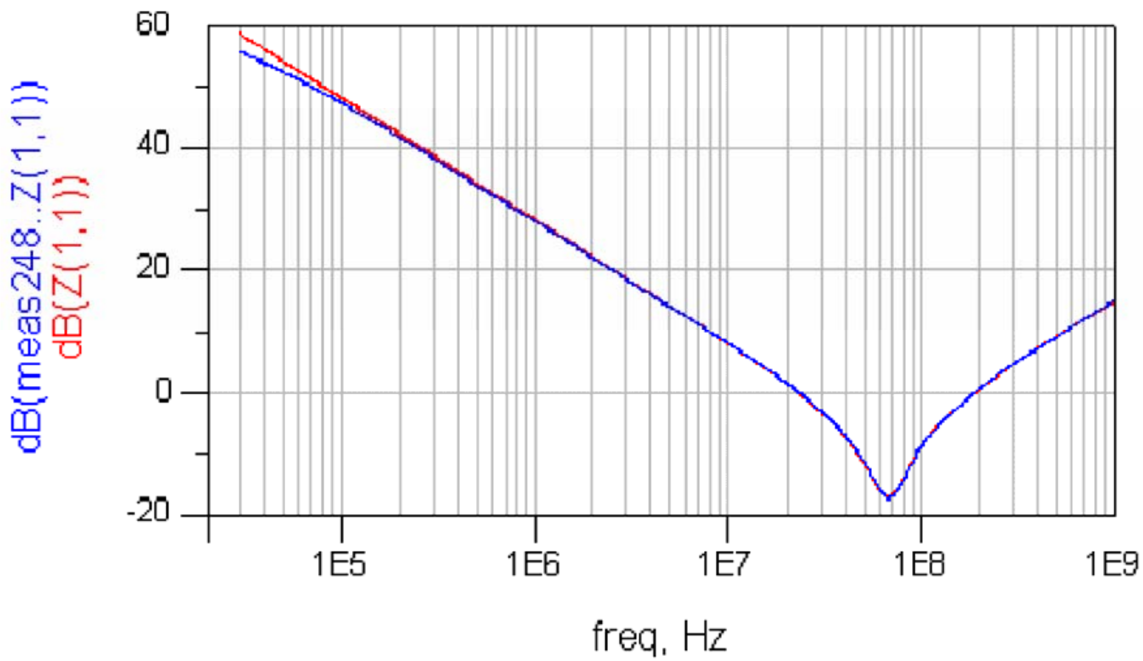
4. Huawei spice circuit model library of capacitor(PI)

➢**Distributed circuit model simulation compared to measured 0.01uF capacitor**



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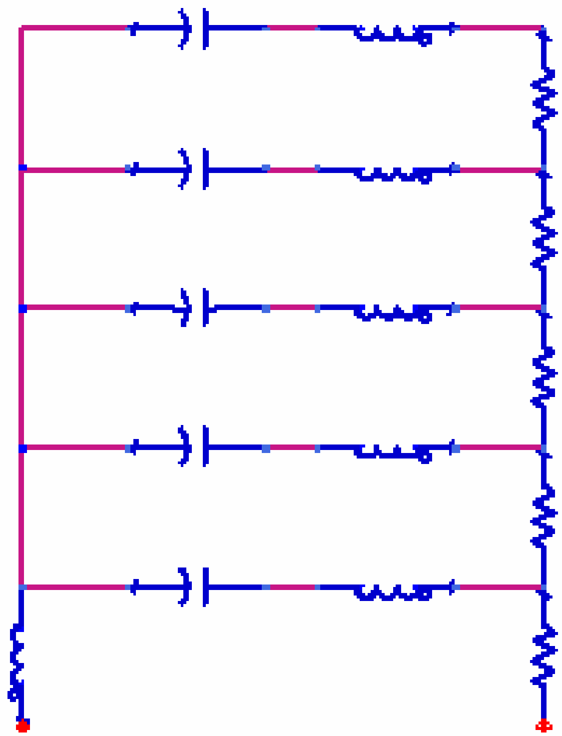
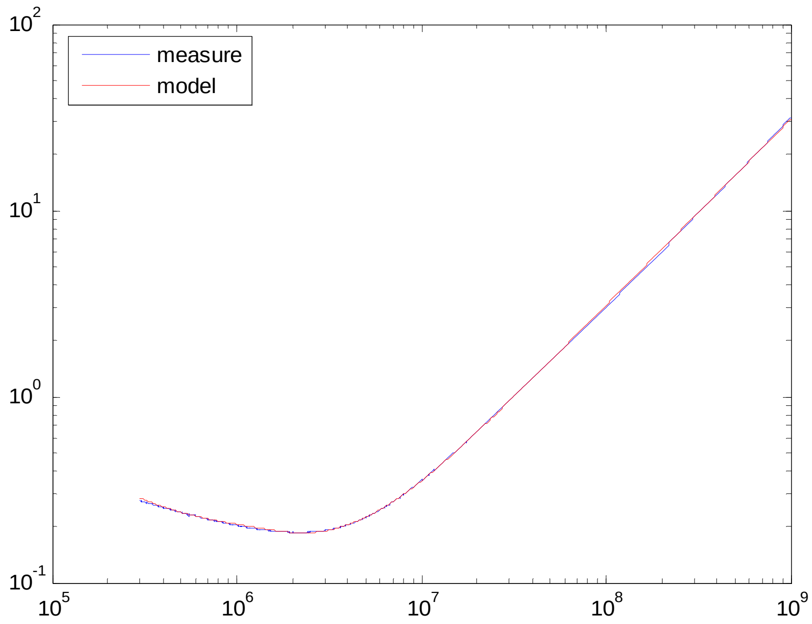
4. Huawei spice circuit model library of capacitor(PI)

➢Spice circuit model of 10uF Tantalum capacitor





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4. Huawei spice circuit model library of capacitor(PI)

➢The spice netlist of 10uF Tantalum capacitor

```
.subckt C_08020059 1 5
+ esr=1m loopInductance=1n
lloop 1 2 loopInductance //  loop or mounted inductance in henries c1 2 1a capacitance
L0    2          3a       1.328655e-009 h
C1    3a         32a      2.090239e-006 f
L1    32a        4a       4.893012e-010 h
R1    4a         3        2.133079e-001 ohm
C2    3a         31a      3.609295e-006 f
L2    31a        6a       1.015527e-009 h
R2    6a         4a       3.549960e-001 ohm
C3    3a         30a      1.426664e-007 f
L3    30a        8a       1.952736e-009 h
R3    8a         6a       8.641232e-001 ohm
C4    3a         29a      5.113291e-007 f
L4    29a        10a      8.165504e-010 h
R4    10a        8a       7.889731e-001 ohm
C5    3a         28a      1.839965e-007 f
L5    28a        12a      6.076517e-010 h
R5    12a        10a      1.088326e+000 ohm
r1 3 4 esr //  esr in ohms
rdum 2 3 10Meg //  resistor to make dc path
vsense 4 5 0 ac=0
.ends C_08020059
```

Element values model was extracted from measured s-parameter based on Monte Carlo method

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5. HUAWEI Simulation platform of power integrity

- Cadence SQPI based two-dimension transmission line theory

  S-parameter:

  Spice model: high-efficiently

- Ansoft Siwave Based electromagnetic theory

  S-parameter

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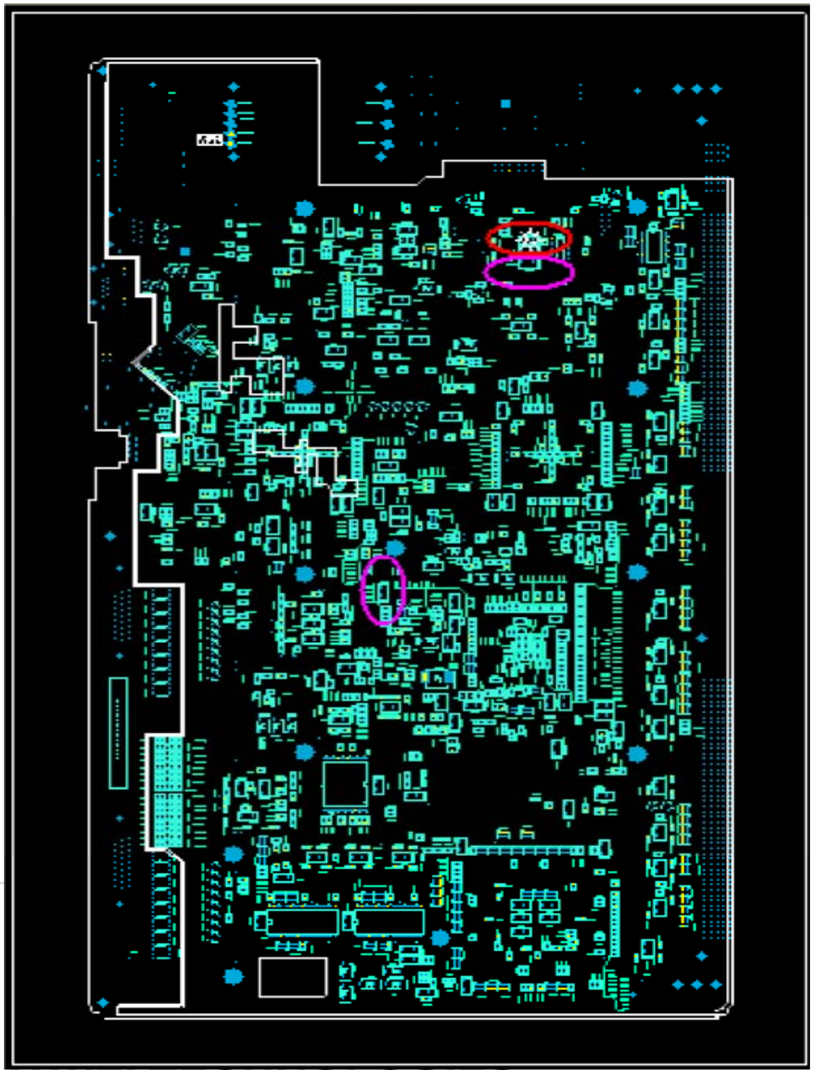
5. HUAWEI Simulation platform of power integrity

➢Simulation of Power integrity for one product



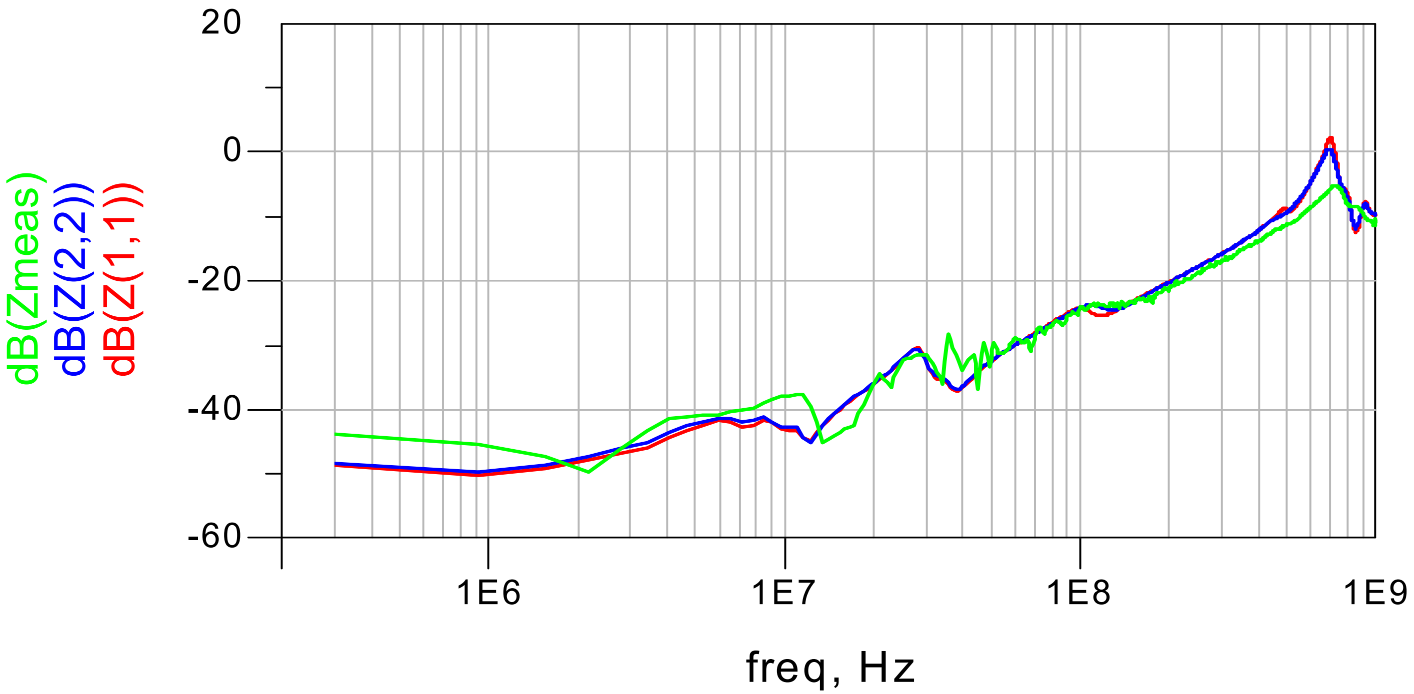
Total pins: 13022 pins

Stackup: 12 layers

Power consumption: 3.3VX20A

5. HUAWEI Simulation platform of power integrity

➢**Simulated and measured impedance of power network for the product**



Red: s-parameter; Blue: spice mode; Green: measurement

6. Conclusion

•HUAWEI have Validated IBIS model Library.

•HUAWEI hold completed and accurate spice model library of passive component;

•Simulation platform of power integrity based on spice model library has been founded;

•The simulated impedance proved to be consistent with measurement and can be used to solve the power noise problem of product.

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7. Reference

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