

IBIS/HSPICE Model Quality Report

Design ID- **u49a**

Description-**2Gb DDR-2 SDRAM**

Marketing device name(s): **MT47H512M4HG, MT47H512M4HG_CLP, MT47H256M8HG, MT47H256M8HG_CLP, MT47H128M16HG, MT47H128M16HG_CLP, MT47H512M4U49A, MT47H256M8U49A, MT47H128M16U49A, MT47H512M4HG-IT, MT47H512M4HG_CLP-IT, MT47H256M8HG-IT, MT47H256M8HG_CLP-IT, MT47H128M16HG-IT, MT47H128M16HG_CLP-IT**

Zip File Name: **u49a_ibis_2p1.zip**

IBIS File name: **u49a.ibs, u49a_bd.ibs, u49a_it.ibs(Rev2.0)** File rev: **2.1**

HSPICE File name: **u49a_hspice_2p1.zip** File rev: **2.1**

EBD file name (if applicable): File rev:

Die Rev: **A**

Date: **06/13/2007**

Datasheet Link (include datasheet link from [micron.com](http://www.micron.com))

<http://www.micron.com/products/partdetail?part=MT47H128M16HG-3>

E-mail at modelsupport@micron.com for questions regarding Quality Report

IBIS Quality Summary

- Include the IBIS Quality Summary information in the Quality report. For details on IBIS Quality check the quality specification and quality checklist on IBIS quality webpage http://www.vhdl.org/pub/ibis/quality_wip/

Include the Ibis quality levels for all components and models in the Ibis file. An example is shown below:

```
#####  
IBIS Quality Notes  
#####  
IQ SUMMARY Overall Quality of component and models Level 2b  
|  
IQ Level 0 - 0 errors 9 warnings  
IQ Level 1 - All checks done for completeness and correctness  
IQ Level 2 - HSPICE Correlation  
IQ Buffer DQ_FULL_533/DQ_FULL_ODT50_533/DQ_FULL_ODT75_533/DQ_FULL_ODT150_533: Quality level 2b  
IQ Buffer DQ_HALF_533/DQ_HALF_ODT50_533/DQ_HALF_ODT75_533/DQ_HALF_ODT150_533: Quality level 2b  
IQ Buffer RDQS_FULL_533/RDQS_HALF_533: Quality level 2b  
IQ Buffer DM_IN_533/DM_ODT50_533/DM_ODT75_533/DM_ODT150_533: Quality level 2b
```

IQ Buffer DQ_FULL_800/DQ_FULL_ODT50_800/DQ_FULL_ODT75_800/DQ_FULL_ODT150_800: Quality level 2b
IQ Buffer DQ_HALF_800/DQ_HALF_ODT50_800/DQ_HALF_ODT75_800/DQ_HALF_ODT150_800: Quality level 2b
IQ Buffer RDQS_FULL_800/RDQS_HALF_800: Quality level 2b
IQ Buffer DM_IN_800/DM_ODT50_800/DM_ODT75_800/DM_ODT150_800: Quality level 2b

IQ Level 0

All Submodels: When running through ibischk4.0, this file contains 18 warnings about pullup and pulldown being non-monotonic. When [Submodel] I-V curves are added to original [Power Clamp] and [Gnd Clamp] curves, the resultant curve is monotonic. This is not checked correctly with the IBIS parser.

IQ Level 1

All Level 1 checks performed and are either OK or NA

IQ Level 2

Using VT IBIS Data compared to source hspice models

IQ Level 2b

C_comp laboratory and hspice correlation

IQ BEGIN IBIS Quality Checklist

IQ FILE: u49a.ibs IQ Level: 1
IQ COMPONENT: MT47H512M4HG IQ Level: 1
IQ COMPONENT: MT47H512M4HG_CLP IQ Level: 1
IQ COMPONENT: MT47H256M8HG IQ Level: 1
IQ COMPONENT: MT47H256M8HG_CLP IQ Level: 1
IQ COMPONENT: MT47H128M16HG IQ Level: 1
IQ COMPONENT: MT47H128M16HG_CLP IQ Level: 1
IQ MODEL: DQ_FULL_533 IQ Level: 2b
IQ MODEL: DQ_FULL_ODT50_533 IQ Level: 2b
IQ MODEL: DQ_FULL_ODT75_533 IQ Level: 2b
IQ MODEL: DQ_FULL_ODT150_533 IQ Level: 2b
IQ MODEL: DQ_HALF_533 IQ Level: 2b
IQ MODEL: DQ_HALF_ODT50_533 IQ Level: 2b
IQ MODEL: DQ_HALF_ODT75_533 IQ Level: 2b
IQ MODEL: DQ_HALF_ODT150_533 IQ Level: 2b
IQ MODEL: RDQS_FULL_533 IQ Level: 2b
IQ MODEL: RDQS_HALF_533 IQ Level: 2b
IQ MODEL: DM_IN_533 IQ Level: 2b
IQ MODEL: DM_ODT50_533 IQ Level: 2b
IQ MODEL: DM_ODT75_533 IQ Level: 2b
IQ MODEL: DM_ODT150_533 IQ Level: 2b
IQ MODEL: IN_533 IQ Level: 2b
IQ MODEL: CLKIN_533 IQ Level: 2b
IQ MODEL: NF_IN_533 IQ Level: 2b
IQ MODEL: DQ_FULL_800 IQ Level: 2b
IQ MODEL: DQ_FULL_ODT50_800 IQ Level: 2b
IQ MODEL: DQ_FULL_ODT75_800 IQ Level: 2b
IQ MODEL: DQ_FULL_ODT150_800 IQ Level: 2b
IQ MODEL: DQ_HALF_800 IQ Level: 2b
IQ MODEL: DQ_HALF_ODT50_800 IQ Level: 2b
IQ MODEL: DQ_HALF_ODT75_800 IQ Level: 2b

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IQ MODEL: DQ_HALF_ODT150_800      IQ Level:  2b
IQ MODEL: RDQS_FULL_800           IQ Level:  2b
IQ MODEL: RDQS_HALF_800           IQ Level:  2b
IQ MODEL: DM_IN_800               IQ Level:  2b
IQ MODEL: DM_ODT50_800            IQ Level:  2b
IQ MODEL: DM_ODT75_800            IQ Level:  2b
IQ MODEL: DM_ODT150_800           IQ Level:  2b
IQ MODEL: IN_800                  IQ Level:  2b
IQ MODEL: CLKIN_800               IQ Level:  2b
IQ MODEL: NF_IN_800               IQ Level:  2b

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IQ END IBIS Quality Checklist

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IBIS Quality Notes

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IQ SUMMARY Overall Quality of component and models Level 2b

IQ Level 0 - 0 errors 9 warnings

IQ Level 1 - All checks done for completeness and correctness

IQ Level 2 - HSPICE Correlation

IQ Buffer DQ_FULL_533/DQ_FULL_ODT50_533/DQ_FULL_ODT75_533/DQ_FULL_ODT150_533: Quality level 2b

IQ Buffer DQ_HALF_533/DQ_HALF_ODT50_533/DQ_HALF_ODT75_533/DQ_HALF_ODT150_533: Quality level 2b

IQ Buffer RDQS_FULL_533/RDQS_HALF_533: Quality level 2b

IQ Buffer DM_IN_533/DM_ODT50_533/DM_ODT75_533/DM_ODT150_533: Quality level 2b

IQ Buffer DQ_FULL_800/DQ_FULL_ODT50_800/DQ_FULL_ODT75_800/DQ_FULL_ODT150_800: Quality level 2b

IQ Buffer DQ_HALF_800/DQ_HALF_ODT50_800/DQ_HALF_ODT75_800/DQ_HALF_ODT150_800: Quality level 2b

IQ Buffer RDQS_FULL_800/RDQS_HALF_800: Quality level 2b

IQ Buffer DM_IN_800/DM_ODT50_800/DM_ODT75_800/DM_ODT150_800: Quality level 2b

IQ Level 0

| All Submodels: When running through ibischk4.0, this file
 | contains 18 warnings about pullup and pulldown being non-monotonic.
 | When [Submodel] I-V curves are added to original [Power Clamp] and
 | [Gnd Clamp] curves, the resultant curve is monotonic. This is not
 | checked correctly with the IBIS parser.

IQ Level 1

| All Level 1 checks performed and are either OK or NA

IQ Level 2

| Using VT IBIS Data compared to source hspice models

IQ Level 2b

| C_comp laboratory and hspice correlation

IQ BEGIN IBIS Quality Checklist

IQ FILE: u49a_bd.ibs IQ Level: 1

IQ COMPONENT: MT47H512M4U49A IQ Level: 1

IQ COMPONENT: MT47H256M8U49A IQ Level: 1

IQ COMPONENT: MT47H128M16U49A IQ Level: 1

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IQ MODEL: DQ_FULL_533           IQ Level:  2b
IQ MODEL: DQ_FULL_ODT50_533     IQ Level:  2b
IQ MODEL: DQ_FULL_ODT75_533     IQ Level:  2b
IQ MODEL: DQ_FULL_ODT150_533    IQ Level:  2b
IQ MODEL: DQ_HALF_533           IQ Level:  2b
IQ MODEL: DQ_HALF_ODT50_533     IQ Level:  2b
IQ MODEL: DQ_HALF_ODT75_533     IQ Level:  2b
IQ MODEL: DQ_HALF_ODT150_533    IQ Level:  2b
IQ MODEL: RDQS_FULL_533         IQ Level:  2b
IQ MODEL: RDQS_HALF_533         IQ Level:  2b
IQ MODEL: DM_IN_533             IQ Level:  2b
IQ MODEL: DM_ODT50_533          IQ Level:  2b
IQ MODEL: DM_ODT75_533          IQ Level:  2b
IQ MODEL: DM_ODT150_533         IQ Level:  2b
IQ MODEL: IN_533                IQ Level:  2b
IQ MODEL: CLKIN_533             IQ Level:  2b
IQ MODEL: NF_IN_533             IQ Level:  2b
IQ MODEL: DQ_FULL_800           IQ Level:  2b
IQ MODEL: DQ_FULL_ODT50_800     IQ Level:  2b
IQ MODEL: DQ_FULL_ODT75_800     IQ Level:  2b
IQ MODEL: DQ_FULL_ODT150_800    IQ Level:  2b
IQ MODEL: DQ_HALF_800           IQ Level:  2b
IQ MODEL: DQ_HALF_ODT50_800     IQ Level:  2b
IQ MODEL: DQ_HALF_ODT75_800     IQ Level:  2b
IQ MODEL: DQ_HALF_ODT150_800    IQ Level:  2b
IQ MODEL: RDQS_FULL_800         IQ Level:  2b
IQ MODEL: RDQS_HALF_800         IQ Level:  2b
IQ MODEL: DM_IN_800             IQ Level:  2b
IQ MODEL: DM_ODT50_800          IQ Level:  2b
IQ MODEL: DM_ODT75_800          IQ Level:  2b
IQ MODEL: DM_ODT150_800         IQ Level:  2b
IQ MODEL: IN_800                IQ Level:  2b
IQ MODEL: CLKIN_800             IQ Level:  2b
IQ MODEL: NF_IN_800             IQ Level:  2b
IQ END IBIS Quality Checklist

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IBIS Quality Notes

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IQ SUMMARY Overall Quality of component and models Level 2b

IQ Level 0 - 0 errors 9 warnings

IQ Level 1 - All checks done for completeness and correctness

IQ Level 2 - HSPICE Correlation

IQ Buffer DQ_FULL_533/DQ_FULL_ODT50_533/DQ_FULL_ODT75_533/DQ_FULL_ODT150_533: Quality level 2b

IQ Buffer DQ_HALF_533/DQ_HALF_ODT50_533/DQ_HALF_ODT75_533/DQ_HALF_ODT150_533: Quality level 2b

IQ Buffer RDQS_FULL_533/RDQS_HALF_533: Quality level 2b

IQ Buffer DM_IN_533/DM_ODT50_533/DM_ODT75_533/DM_ODT150_533: Quality level 2b

IQ Buffer DQ_FULL_800/DQ_FULL_ODT50_800/DQ_FULL_ODT75_800/DQ_FULL_ODT150_800: Quality level 2b

IQ Buffer DQ_HALF_800/DQ_HALF_ODT50_800/DQ_HALF_ODT75_800/DQ_HALF_ODT150_800: Quality level 2b

IQ Buffer RDQS_FULL_800/RDQS_HALF_800: Quality level 2b

IQ Buffer DM_IN_800/DM_ODT50_800/DM_ODT75_800/DM_ODT150_800: Quality level 2b

IQ Level 0

All Submodels: When running through ibischk4.0, this file contains 9 warnings about pullup and pulldown being non-monotonic. When [Submodel] I-V curves are added to original [Power Clamp] and [Gnd Clamp] curves, the resultant curve is monotonic. This is not checked correctly with the IBIS parser.

IQ WARNING (line 11668) - GND Clamp Minimum data is non-monotonic
IQ WARNING (line 11671) - GND Clamp Typical data is non-monotonic
IQ WARNING (line 11674) - GND Clamp Maximum data is non-monotonic
IQ WARNING (line 11791) - GND Clamp Minimum data is non-monotonic
IQ WARNING (line 11794) - GND Clamp Typical data is non-monotonic
IQ WARNING (line 11797) - GND Clamp Maximum data is non-monotonic
IQ WARNING (line 11914) - GND Clamp Minimum data is non-monotonic
IQ WARNING (line 11918) - GND Clamp Typical data is non-monotonic
IQ WARNING (line 11921) - GND Clamp Maximum data is non-monotonic

IQ Level 1

All Level 1 checks performed and are either OK or NA

IQ Level 2

Using VT IBIS Data compared to source hspice models

IQ Level 2b

C_comp laboratory and hspice correlation

IQ BEGIN IBIS Quality Checklist

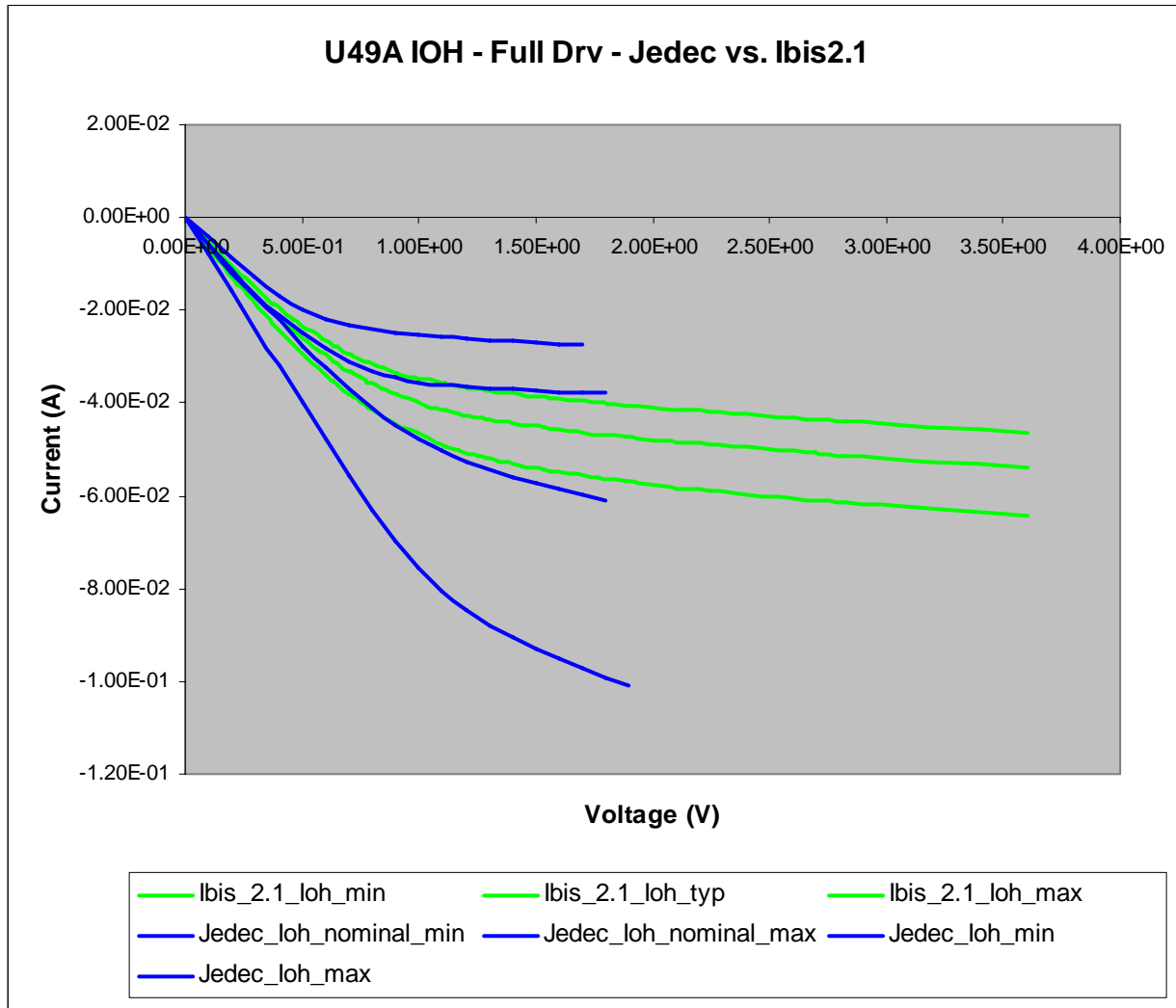
IQ FILE: u49a_it.ibs IQ Level: 1
IQ COMPONENT: MT47H512M4HG-IT IQ Level: 1
IQ COMPONENT: MT47H512M4HG_CLP-IT IQ Level: 1
IQ COMPONENT: MT47H256M8HG-IT IQ Level: 1
IQ COMPONENT: MT47H256M8HG_CLP-IT IQ Level: 1
IQ COMPONENT: MT47H128M16HG-IT IQ Level: 1
IQ COMPONENT: MT47H128M16HG_CLP-IT IQ Level: 1
IQ MODEL: DQ_FULL_533 IQ Level: 2b
IQ MODEL: DQ_FULL_ODT50_533 IQ Level: 2b
IQ MODEL: DQ_FULL_ODT75_533 IQ Level: 2b
IQ MODEL: DQ_FULL_ODT150_533 IQ Level: 2b
IQ MODEL: DQ_HALF_533 IQ Level: 2b
IQ MODEL: DQ_HALF_ODT50_533 IQ Level: 2b
IQ MODEL: DQ_HALF_ODT75_533 IQ Level: 2b
IQ MODEL: DQ_HALF_ODT150_533 IQ Level: 2b
IQ MODEL: RDQS_FULL_533 IQ Level: 2b
IQ MODEL: RDQS_HALF_533 IQ Level: 2b
IQ MODEL: DM_IN_533 IQ Level: 2b
IQ MODEL: DM_ODT50_533 IQ Level: 2b
IQ MODEL: DM_ODT75_533 IQ Level: 2b
IQ MODEL: DM_ODT150_533 IQ Level: 2b
IQ MODEL: IN_533 IQ Level: 2b
IQ MODEL: CLKIN_533 IQ Level: 2b
IQ MODEL: NF_IN_533 IQ Level: 2b

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IQ MODEL: DQ_FULL_800           IQ Level:  2b
IQ MODEL: DQ_FULL_ODT50_800     IQ Level:  2b
IQ MODEL: DQ_FULL_ODT75_800     IQ Level:  2b
IQ MODEL: DQ_FULL_ODT150_800    IQ Level:  2b
IQ MODEL: DQ_HALF_800           IQ Level:  2b
IQ MODEL: DQ_HALF_ODT50_800     IQ Level:  2b
IQ MODEL: DQ_HALF_ODT75_800     IQ Level:  2b
IQ MODEL: DQ_HALF_ODT150_800    IQ Level:  2b
IQ MODEL: RDQS_FULL_800         IQ Level:  2b
IQ MODEL: RDQS_HALF_800         IQ Level:  2b
IQ MODEL: DM_IN_800            IQ Level:  2b
IQ MODEL: DM_ODT50_800         IQ Level:  2b
IQ MODEL: DM_ODT75_800         IQ Level:  2b
IQ MODEL: DM_ODT150_800        IQ Level:  2b
IQ MODEL: IN_800               IQ Level:  2b
IQ MODEL: CLKIN_800            IQ Level:  2b
IQ MODEL: NF_IN_800            IQ Level:  2b
IQ END IBIS Quality Checklist
#####
|
```

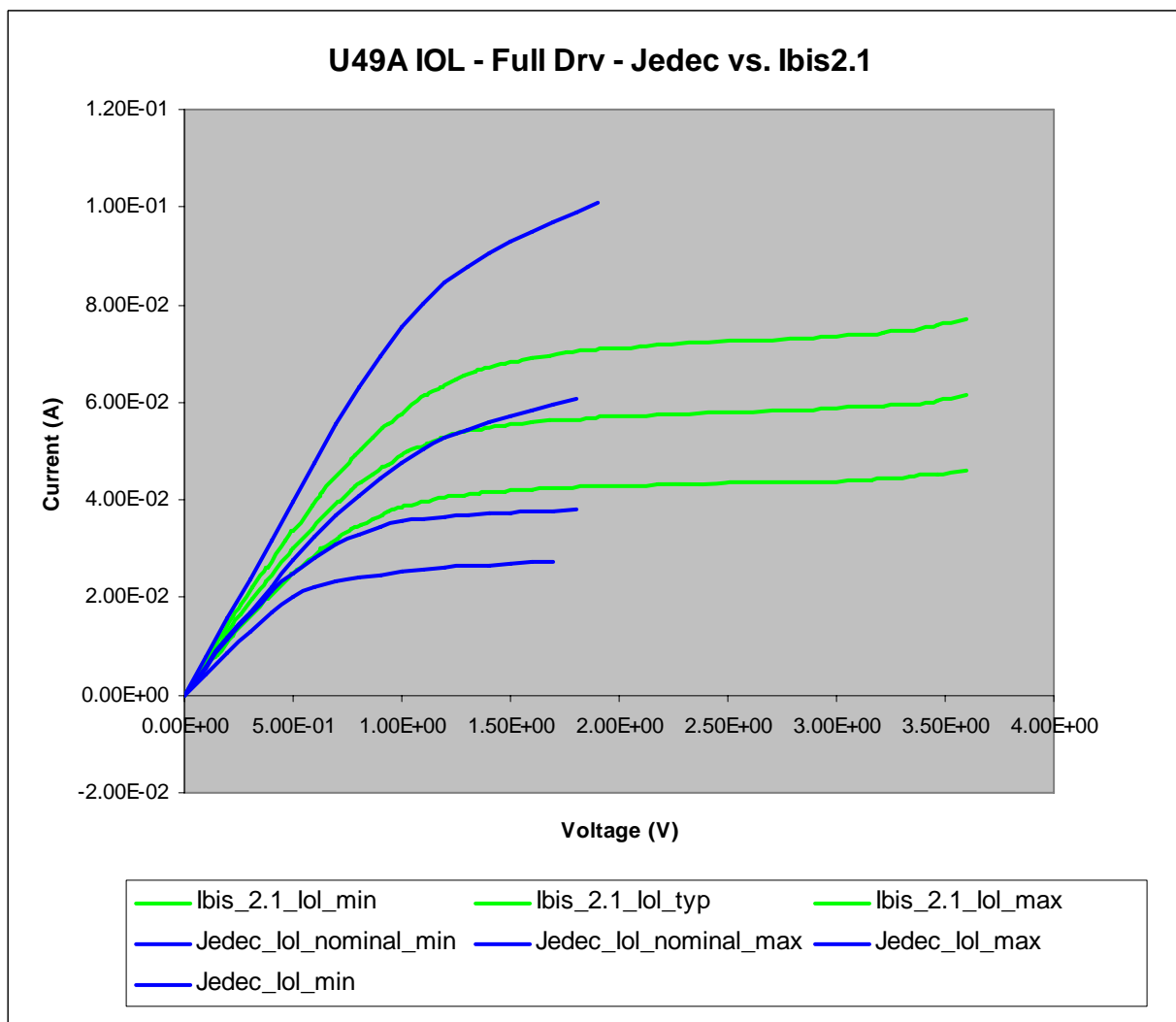
IBIS MODEL Correlation

Datasheet Correlation

1. For Output model or I/O model compare datasheet IOH/IOL data with Ibis pullup/pulldown data.
 - a. Model Name ex DQFULL
 - i. Insert pullup comparison image from IBISCNTR or Model Integrity



ii. Insert pulldown comparison image from IBISCNTR or Model Integrity



2. Compare C_comp with datasheet Input C. Provide c_comp comparison table for all models and for all package combinations (i.e x4, x8 and x16)

Insert component name here **x4x8 MT47H512M4HG, MT47H256M8HG, MT47H512M4HG_CLP, MT47H256M8HG_CLP, MT47H512M4HG-IT, MT47H256M8HG-IT, MT47H512M4HG_CLP-IT, MT47H256M8HG_CLP-IT**

		IBIS		Datasheet	
		Min	max	min	max
DQ	C_comp	2.567pF	3.054pF	NA	NA
	C package	0.113pF	0.186pF	NA	NA

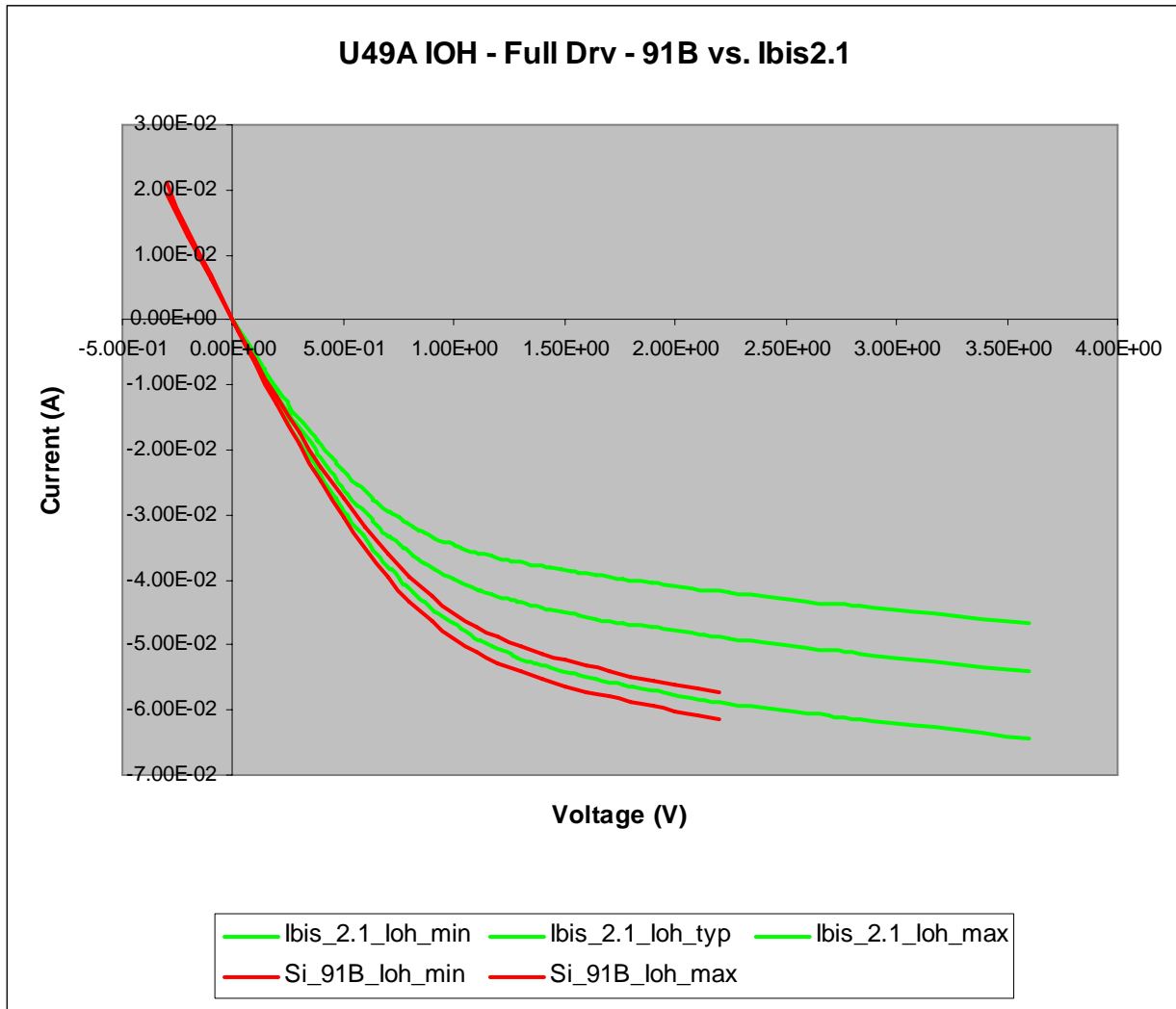
	C_total	2.68pF	3.24pF	2.5pF	3.5pF
INPUT	C_comp	1.179pF	1.579pF	A	NA
	C_package	0.111pF	0.191pF	NA	NA
	C_total	1.29pF	1.77pF	1.0pF	1.75pF
CLK	C_comp	1.191pF	1.569pF	NA	NA
	C_package	0.159pF	0.161pF	NA	NA
	C_total	1.35pF	1.73pF	1.0pF	1.75pF

Insert component name here **x16 MT47H128M16HG, MT47H128M16HG_CLP, MT47H128M16HG-IT, MT47H128M16HG_CLP-IT**

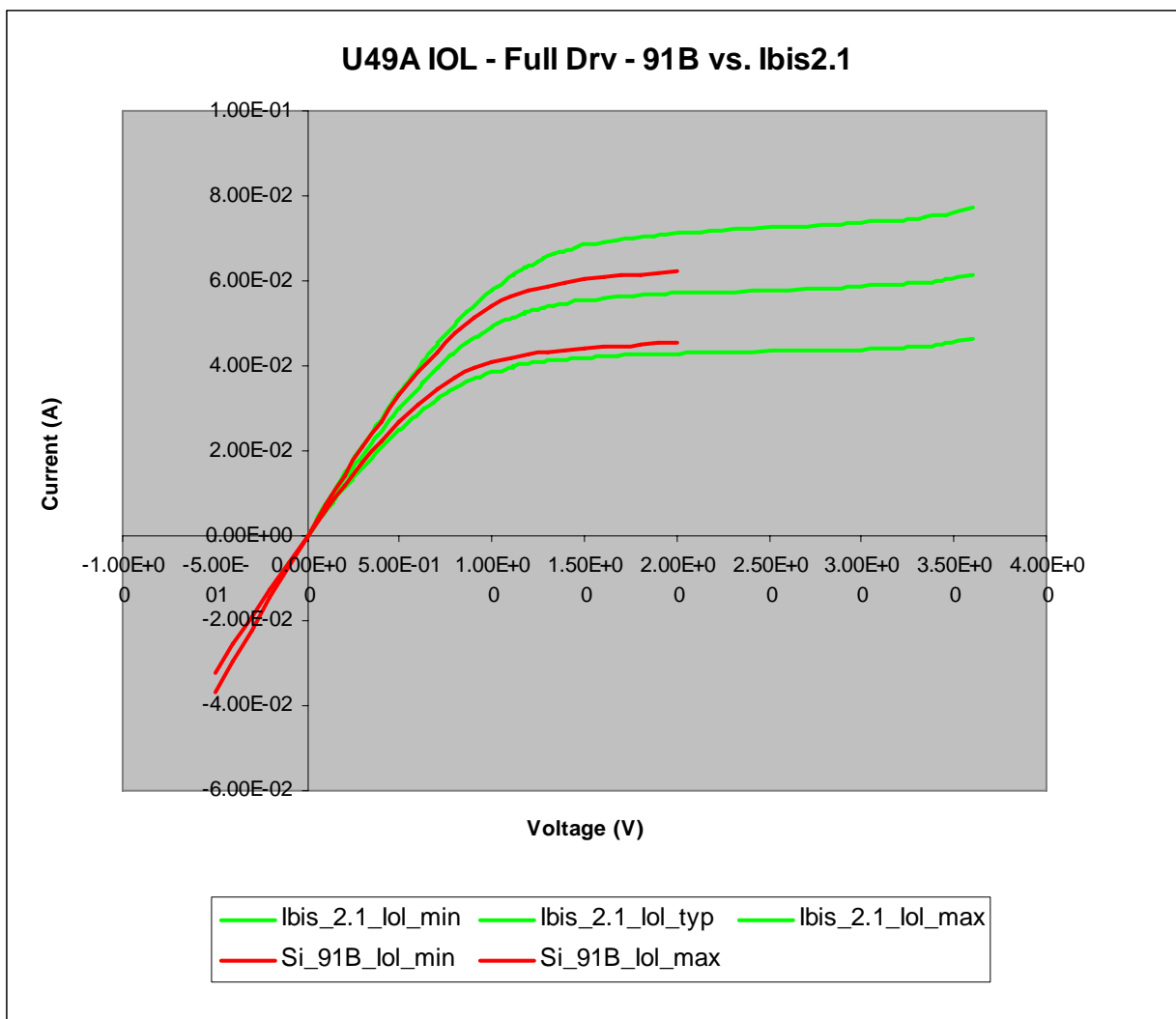
		IBIS		Datasheet	
		Min	max	min	max
DQ	C_comp	2.567pF	3.054pF	NA	NA
	C_package	0.113pF	0.186pF	NA	NA
	C_total	2.68pF	3.24pF	2.5pF	3.5pF
INPUT	C_comp	1.179pF	1.58pF	A	NA
	C_package	0.111pF	0.189pF	NA	NA
	C_total	1.29pF	1.77pF	1.0pF	1.75pF
CLK	C_comp	1.204pF	1.58pF	NA	NA
	C_package	0.146pF	0.154pF	NA	NA
	C_total	1.35pF	1.73pF	1.0pF	1.75pF

Measurement Correlation

1. For Output model or I/O model compare measured IOH/IOL data with Ibis pullup pulldown data. If the measurement condition is different than Ibis condition, run hspice simulation using the same measurement condition, for example Vcc, temp and process. Include measurement conditions in the pullup/pulldown images.
 - a. Model Name **ex DQFULL**
 - i. Insert pullup comparison image from IBISCNTR or Model Integrity



ii. Insert pulldown comparison image from IBISCNTR or Model Integrity



2. Compare c_comp with measured c_comp. Provide c_comp comparison table for all models and for all package combinations (i.e x4, x8 and x16)

Insert component name here [x4x8 MT47H512M4HG](#), [MT47H256M8HG](#), [MT47H512M4HG_CLP](#), [MT47H256M8HG_CLP](#), [MT47H512M4HG-IT](#), [MT47H256M8HG-IT](#), [MT47H512M4HG_CLP-IT](#), [MT47H256M8HG_CLP-IT](#)

		IBIS			Measured		
		min	Typ	max	min	typ	max
DQ	C_comp	2.567pF	2.81pF	3.054pF	NA	NA	NA
	C_package	0.113pF	0.15pF	0.186pF	NA	NA	NA
	C_total	2.68pF	2.96pF	3.24pF	2.83pF	2.96pF	3.09pF
INPUT	C_comp	1.179pF	1.379pF	1.579pF	NA	NA	NA

	C_package	0.111pF	0.151pF	0.191pF	NA	NA	NA
	C_total	1.29pF	1.53pF	1.77pF	1.44pF	1.53pF	1.62pF
CLK	C_comp	1.191pF	1.38pF	1.569pF	NA	NA	NA
	C_package	0.159pF	0.16pF	0.161pF	NA	NA	NA
	C_total	1.35pF	1.54pF	1.73pF	1.50pF	1.54pF	1.58pF

Insert component name here **x16 MT47H128M16HG, MT47H128M16HG_CLP, MT47H128M16HG-IT, MT47H128M16HG_CLP-IT**

		IBIS			Measured		
		min	Typ	max	min	typ	max
DQ	C_comp	2.567pF	2.81pF	3.054pF	NA	NA	NA
	C_package	0.113pF	0.15pF	0.186pF	NA	NA	NA
	C_total	2.68pF	2.96pF	3.24pF	2.83pF	2.96pF	3.09pF
INPUT	C_comp	1.179pF	1.38pF	1.58pF	NA	NA	NA
	C_package	0.111pF	0.15pF	0.189pF	NA	NA	NA
	C_total	1.29pF	1.53pF	1.77pF	1.44pF	1.53pF	1.62pF
CLK	C_comp	1.204pF	1.39pF	1.58pF	NA	NA	NA
	C_package	0.146pF	0.15pF	0.154pF	NA	NA	NA
	C_total	1.35pF	1.54pF	1.73pF	1.50pF	1.54pF	1.58pF

3. If measured clamp current data is available provide an IBIS and Silicon clamp comparison for all models
 - a. Model Name **ex DQFULL**
 - i. Insert power-clamp comparison image from IBISCNTR or Model Integrity
 - ii. Insert gnd-clamp comparison image from IBISCNTR or Model Integrity

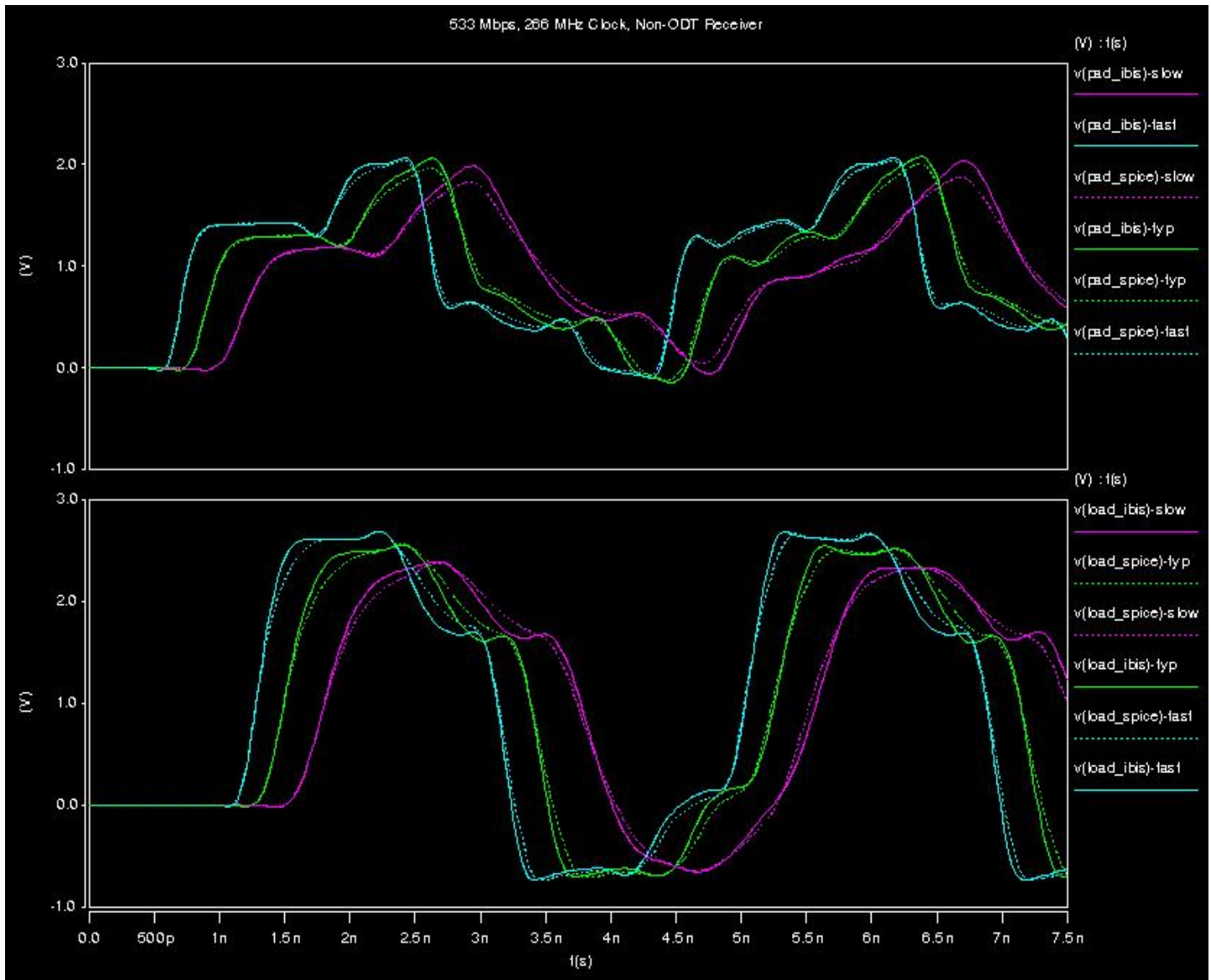
Not Available

IBIS vs HSPICE Correlation

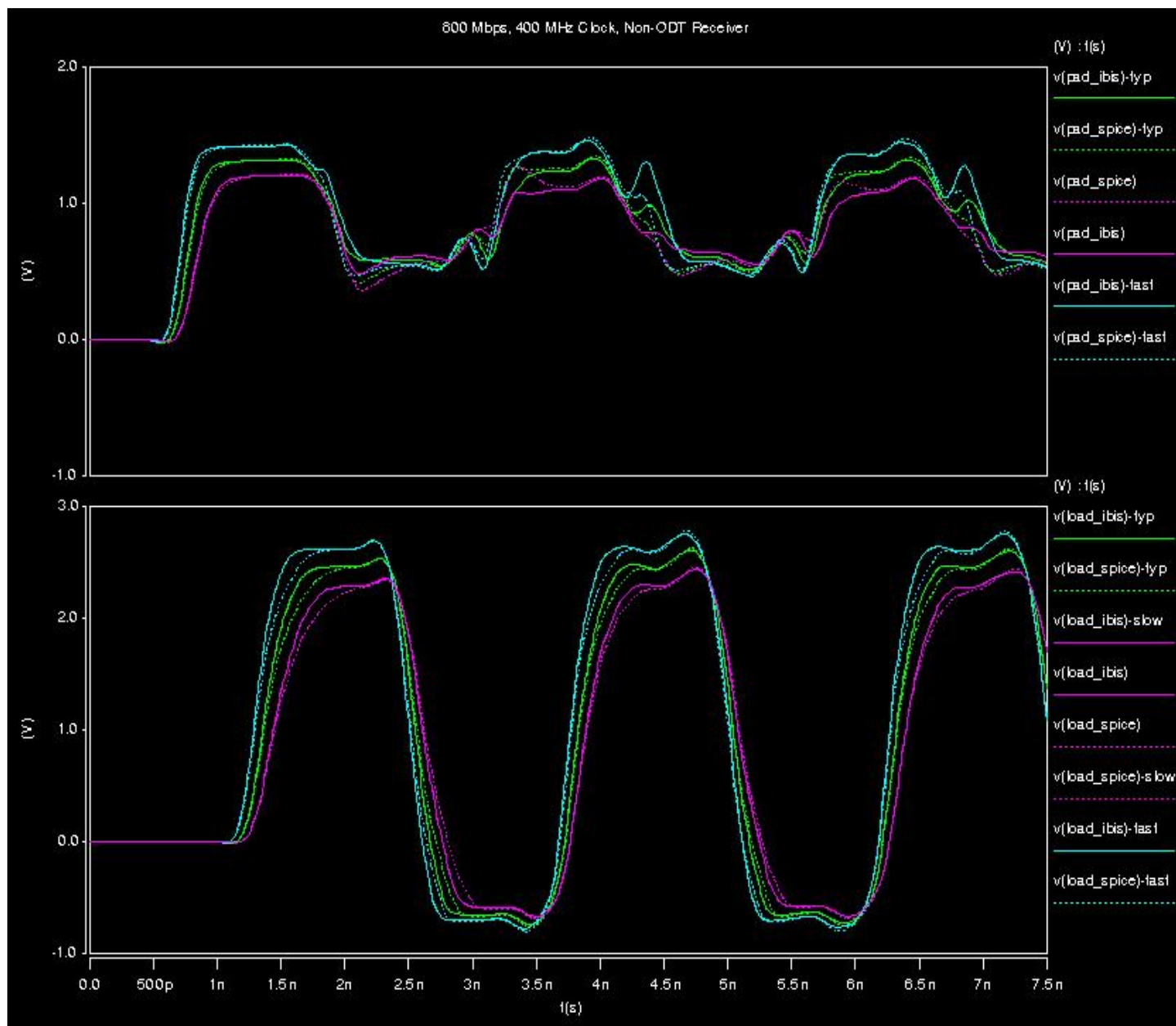
1. For all output model or I/O model run hspice transient simulation using encrypted netlist and using IBIS model (b-element).
 - a. Use the below setup and node naming conventions for the Ibis and Hspice deck file (.sp file). Indicate and update the setup diagram if it is different. Indicate version of Hspice simulator used for simulation (ex. Hspice 2006.09)
Note: Hspice version used for correlation is 2006.09. 2007.03 was used for general simulations
 - b. Run simulation for all corners cases and at maximum allowable speed grade
Note: Speed Grade: 800Mbps and 533Mbps

Example of IBIS vs Hspice correlation in DDR2 Ibis model is shown below

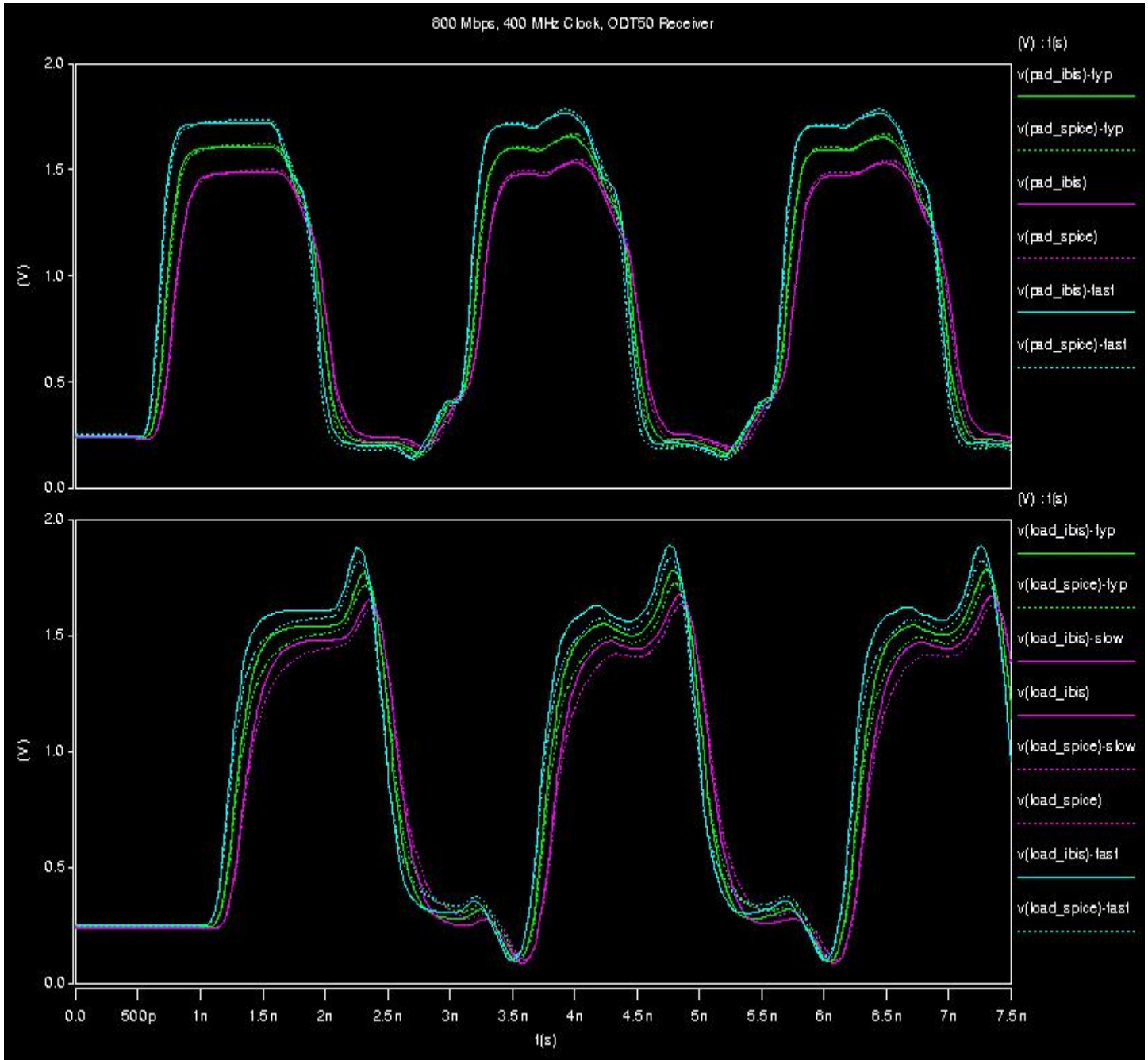
i. DQFULL driving DQFULL with no ODT - 533Mbps



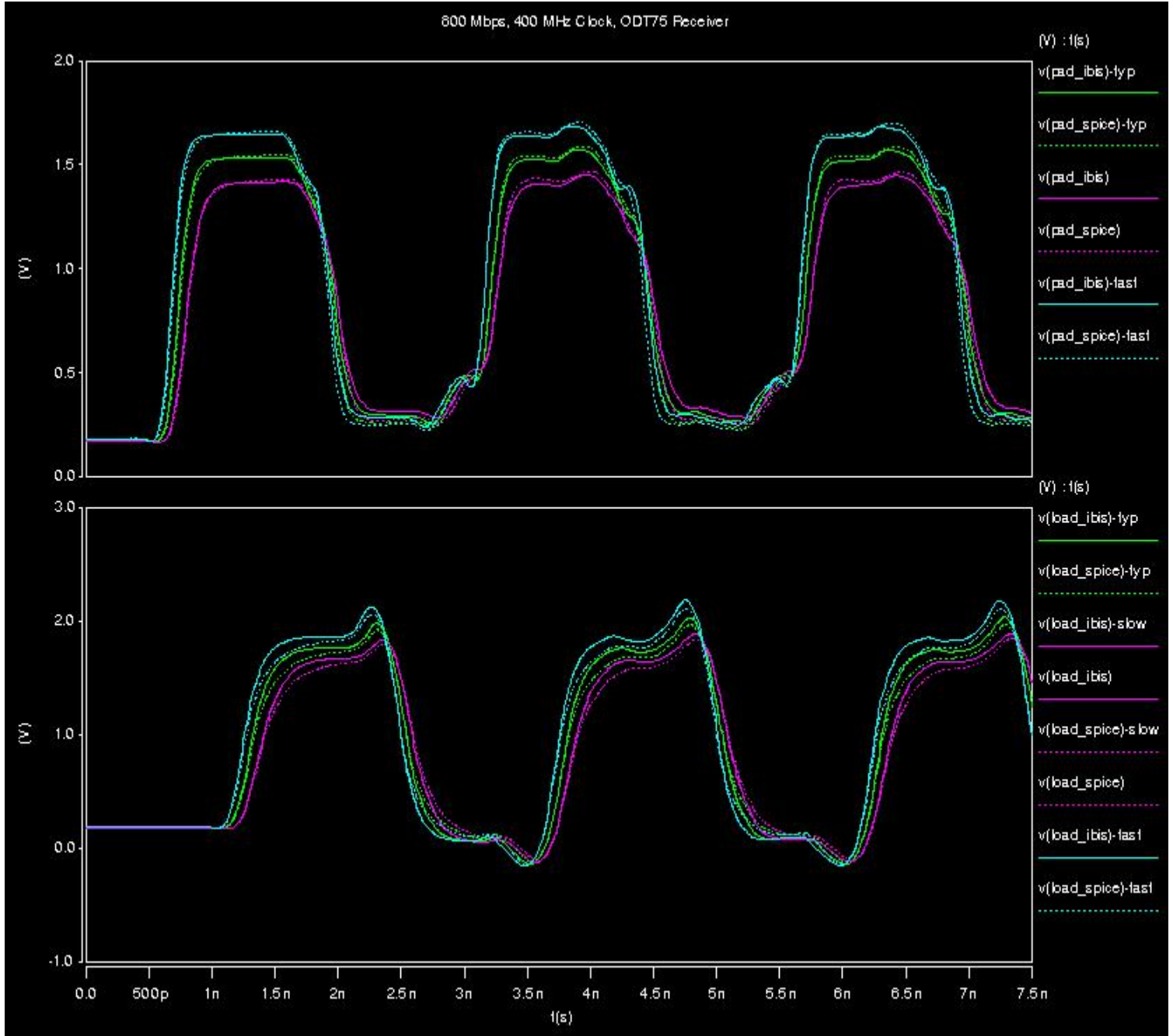
ii. DQFULL driving DQFULL with no ODT – 800Mbps



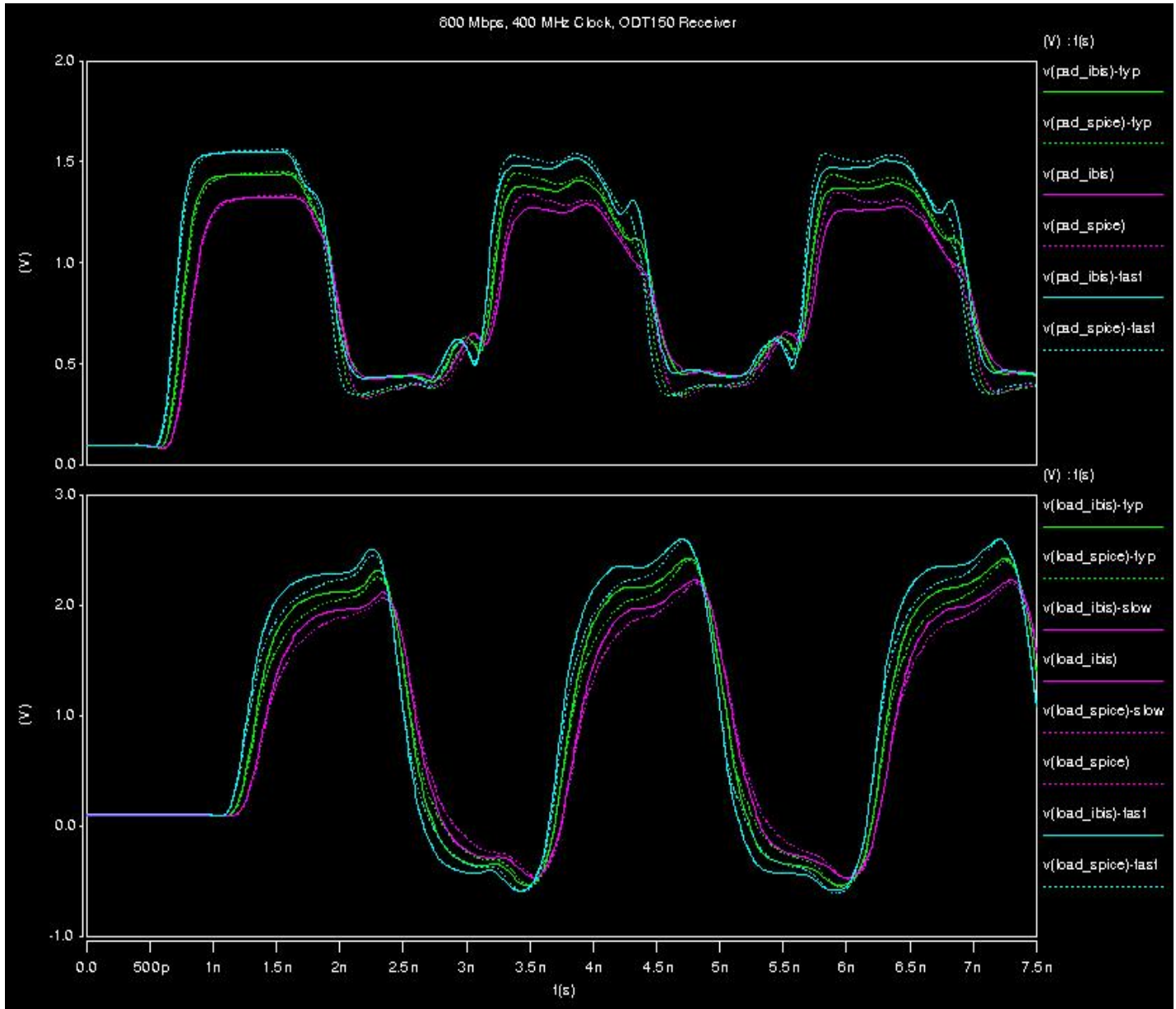
iii. DQFULL driving DQFULL with 50 Ohm ODT – 800Mbps



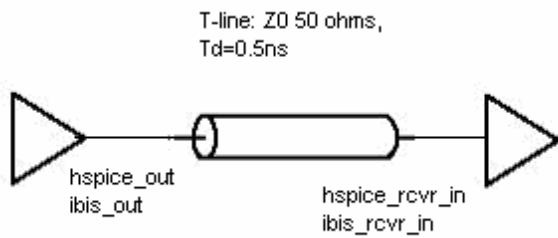
iv. DQFULL driving DQFULL with 75 Ohm ODT – 800Mbps



v. DQFULL driving DQFULL with 150 Ohm ODT – 800Mbps



Setup



Comments:

Document Revision history

Rev 1.0- 06/13/2007, matched to IBIS rev2.1