

## IBIS/HSPICE Model Quality Report

Design ID: **T37Z**

Description: **512Mb DDR SDRAM**

Marketing device name(s): **MT46V128M4TG, MT46V64M8TG, MT46V32M16TG, MT46V128M4FN, MT46V64M8FN, MT46V32M16FN**

Valid Speed Grades: **DDR-266/333/400**

Zip File Name: **t37z\_ibis.zip, t37z\_spice.zip**

IBIS File name: **t37z.ibs, t37z\_it.ibs** File rev: **2.3, 2.1**

HSPICE File name: **t37z\_spice.zip** File rev: **2.3**

EBD file name (if applicable): File rev:

Die Rev: **F**

Date: **October 22, 2009**

Datasheet Link: <http://download.micron.com/pdf/datasheets/dram/ddr/512MBDDRx4x8x16.pdf>

E-mail at [modelsupport@micron.com](mailto:modelsupport@micron.com) for questions regarding Quality Report

### Device Parameters

VDDQ – Slow: **2.3** Typical: **2.5** Fast: **2.7**

VDD – Slow: **2.3** Typical: **2.5** Fast: **2.7**

VDDQ-DDR400 – Slow: **2.5** Typical: **2.6** Fast: **2.7**

VDD-DDR400 – Slow: **2.5** Typical: **2.6** Fast: **2.7**

Junction Temperature (Commercial) - Slow: **85C** Typical: **40C** Fast: **0C**

Junction Temperature (Industrial) - Slow: **100C** Typical: **40C** Fast: **-40C**

VDDQ/VSSQ Decoupling Capacitance: **630pF**

Included in HSPICE DQ/DQS models? **Yes** Amount per DQ/DQS model: **35pF**

VDDQ/VSSQ Decoupling Capacitance Series Resistance: **1 ohm**

### 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/](http://www.vhdl.org/pub/ibis/quality_wip/)

Include the IBIS quality levels for all components and models in the IBIS file.

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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 0 warnings

IQ Level 1 - All checks done for completeness and correctness

IQ Level 2 – HSPICE/Measurement Correlation

IQ Buffer DQ\_FULL\_333/DQ\_FULL\_400: Quality level 2b

IQ Buffer DQ2\_FULL\_333/DQ2\_FULL\_400: Quality level 2b

IQ Buffer DQ\_HALF\_333/DQ\_HALF\_400: Quality level 2b

IQ Buffer DQ2\_HALF\_333/DQ2\_HALF\_400: Quality level 2b

IQ Buffer DM\_333/DM\_400: Quality level 2b

IQ Buffer IN\_333/IN\_400: Quality level 2b

IQ Buffer IN2\_333/IN2\_400: Quality level 2b

IQ Buffer CLK\_333/CLK\_400: Quality level 2b

IQ Level 0

When running through ibischk4.2, this file contains an

additional 10 warnings about missing Differential

[Receiver Thresholds]. These warnings can be removed by

un-commenting lines in CLK\* models.

IQ Level 1

All Level 1 checks performed and are either OK or NA

IQ Level 2b

Using V-t IBIS Data compared to source HSPICE models

Using I-V Data compared to measurement data

Using C\_comp compared to measurement data

IQ BEGIN IBIS Quality Checklist

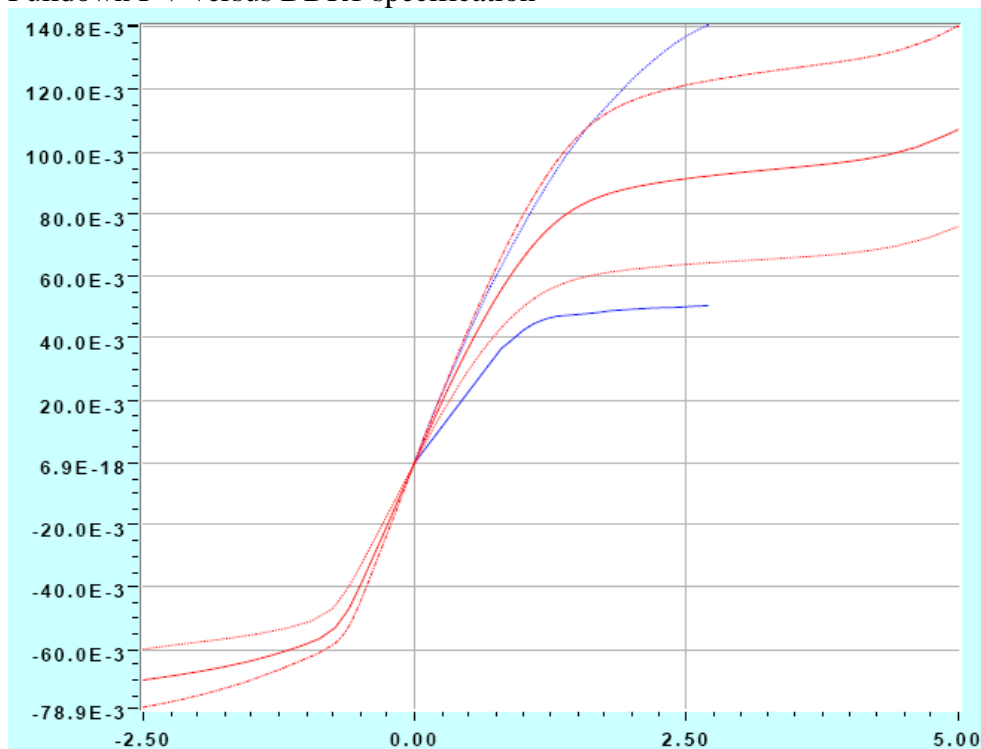
IQ FILE: t37z.ibs	IQ Level: 1
IQ COMPONENT: MT46V128M4TG	IQ Level: 1
IQ COMPONENT: MT46V64M8TG	IQ Level: 1
IQ COMPONENT: MT46V32M16TG	IQ Level: 1
IQ COMPONENT: MT46V128M4FN	IQ Level: 1
IQ COMPONENT: MT46V64M8FN	IQ Level: 1
IQ COMPONENT: MT46V32M16FN	IQ Level: 1
IQ MODEL: DQ_FULL_333	IQ Level: 2b
IQ MODEL: DQ_FULL_400	IQ Level: 2b
IQ MODEL: DQ_HALF_333	IQ Level: 2b
IQ MODEL: DQ_HALF_400	IQ Level: 2b
IQ MODEL: DQ2_FULL_333	IQ Level: 2b
IQ MODEL: DQ2_FULL_400	IQ Level: 2b

IQ MODEL: DQ2_HALF_333	IQ Level: 2b
IQ MODEL: DQ2_HALF_400	IQ Level: 2b
IQ MODEL: DM_333	IQ Level: 2b
IQ MODEL: DM_400	IQ Level: 2b
IQ MODEL: IN_333	IQ Level: 2b
IQ MODEL: IN_400	IQ Level: 2b
IQ MODEL: IN2_333	IQ Level: 2b
IQ MODEL: IN2_400	IQ Level: 2b
IQ MODEL: CLK_333	IQ Level: 2b
IQ MODEL: CLK_400	IQ Level: 2b
IQ END IBIS Quality Checklist	

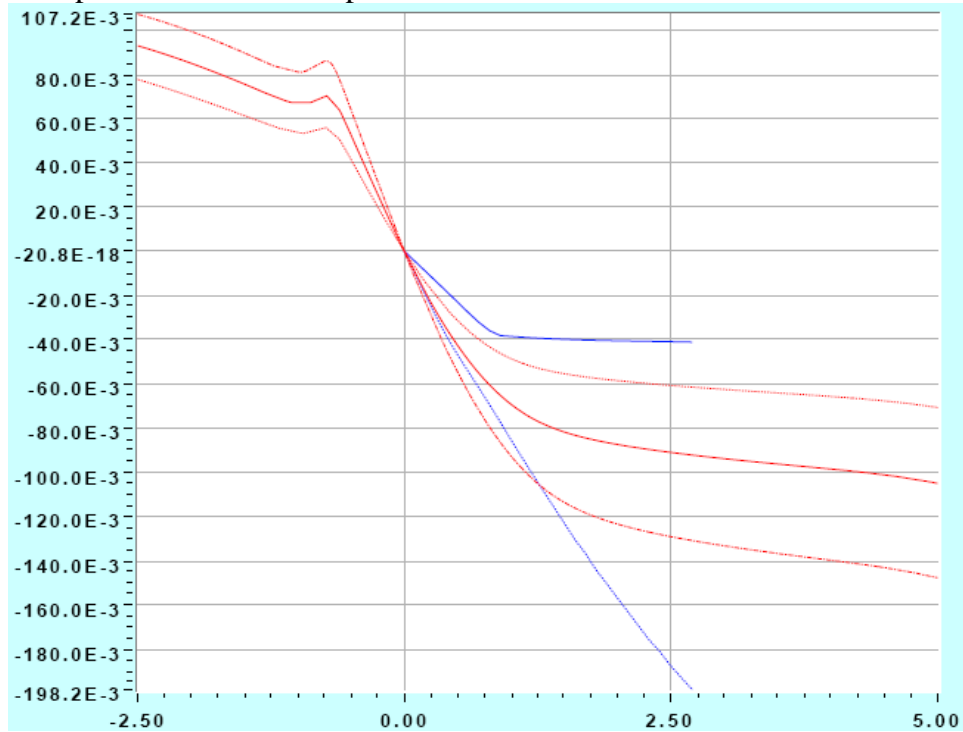
### IBIS MODEL Correlation

#### Datasheet Correlation

1.  For Output model or I/O model compare datasheet IOH/IOL data with IBIS pullup/pulldown data.
  - a. Model Name **DQ\_FULL\_333**
    - i. Pulldown I-V versus DDR1 specification

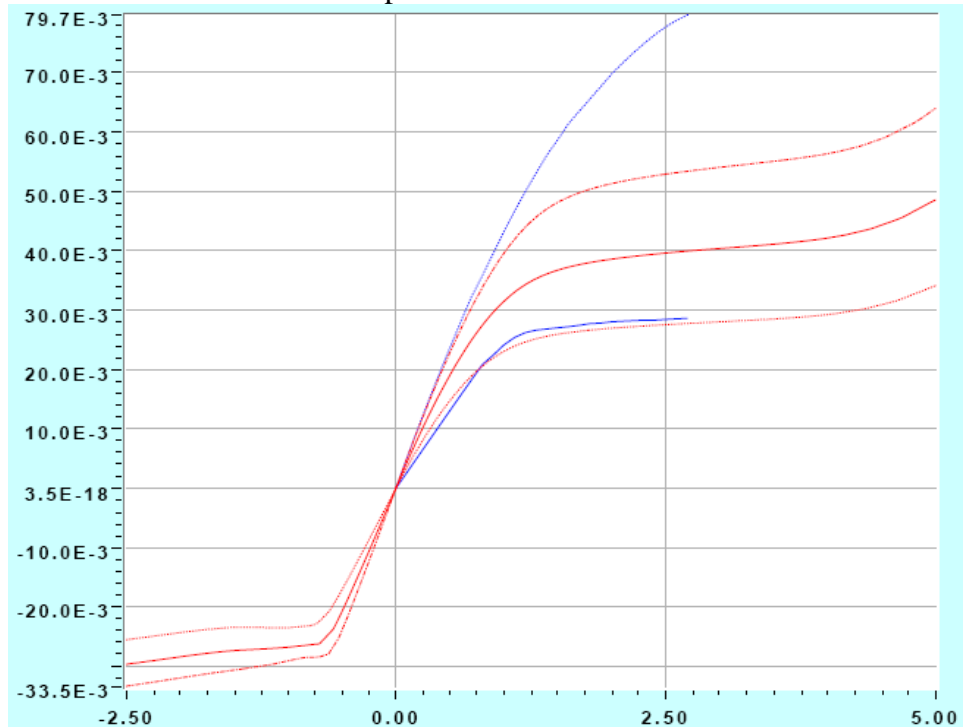


ii. Pullup I-V versus DDR1 specification

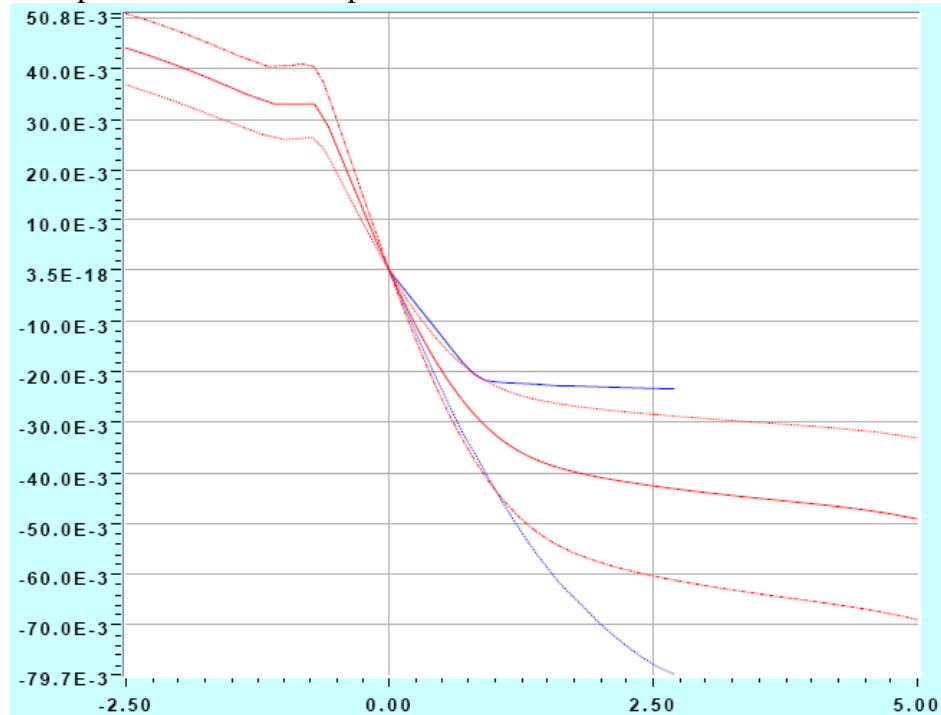


b. Model Name [DQ\\_HALF\\_333](#)

i. Pulldown I-V versus DDR1 specification



ii. Pullup I-V versus DDR1 specification



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 **MT46V32M16FN**

		IBIS		Datasheet	
		min	max	min	max
<b>DQ</b>	C_comp	2.850	3.150	NA	NA
	C_package	0.210	0.566	NA	NA
	C_total	3.060	3.716	3.500	4.500
<b>DQ2</b>	C_comp	3.150	3.450	NA	NA
	C_package	0.419	0.447	NA	NA
	C_total	3.569	3.897	3.500	4.500
<b>DM</b>	C_comp	3.700	4.000	NA	NA
	C_package	0.423	0.434	NA	NA
	C_total	4.123	4.434	3.500	4.500
<b>INPUT</b>	C_comp	1.100	1.400	NA	NA
	C_package	0.400	0.618	NA	NA
	C_total	1.500	2.018	1.500	2.500
<b>INPUT2</b>	C_comp	1.250	1.550	NA	NA
	C_package	0.407	0.407	NA	NA
	C_total	1.657	1.957	1.500	2.500

<b>CLK</b>	C_comp	1.250	1.550	NA	NA
	C_package	0.421	0.434	NA	NA
	C_total	1.671	1.984	1.500	2.500

Insert component name here **MT46V32M16TG**

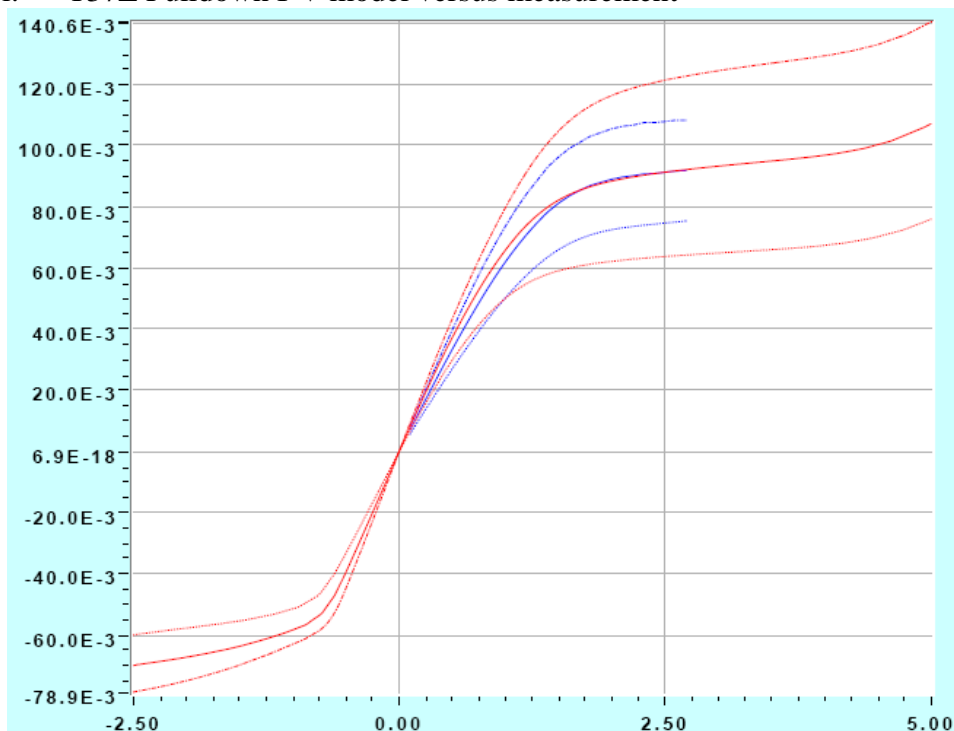
		IBIS		Datasheet	
		min	max	min	max
<b>DQ</b>	C_comp	2.850	3.150	NA	NA
	C_package	1.026	1.368	NA	NA
	C_total	3.876	4.518	4.000	5.000
<b>DQ2</b>	C_comp	3.150	3.450	NA	NA
	C_package	0.819	0.990	NA	NA
	C_total	3.969	4.440	4.000	5.000
<b>DM</b>	C_comp	3.700	4.000	NA	NA
	C_package	0.927	0.936	NA	NA
	C_total	4.627	4.936	4.000	5.000
<b>INPUT</b>	C_comp	1.100	1.400	NA	NA
	C_package	0.999	1.386	NA	NA
	C_total	2.099	2.786	2.000	3.000
<b>INPUT2</b>	C_comp	1.250	1.550	NA	NA
	C_package	1.143	1.143	NA	NA
	C_total	2.393	2.693	2.000	3.000
<b>CLK</b>	C_comp	1.250	1.550	NA	NA
	C_package	0.963	0.990	NA	NA
	C_total	2.213	2.540	2.000	3.000

3.  If slew rate specifications (Rise slew and Fall slew) are available from the datasheet, complete HSPICE simulation to generate slew rate data and provide a comparison table.

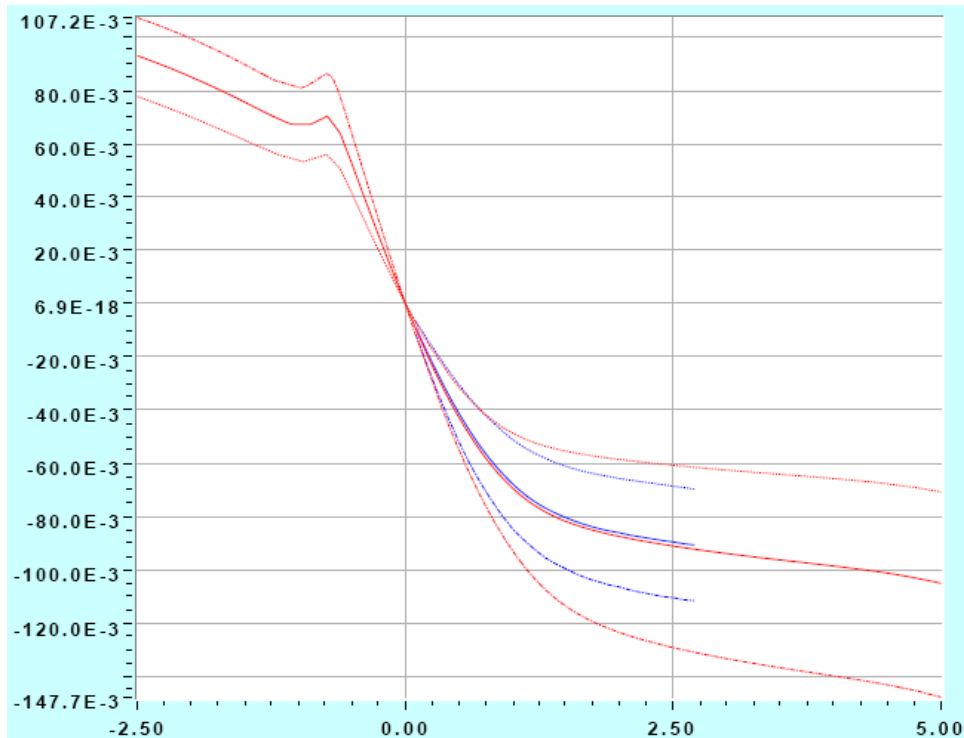
		IBIS			Datasheet	
Model	Slew Rate (V/ns)	min	typ	max	min	max
<b>DQ Full</b>	Rising					
	Falling					
<b>DQ Half</b>	Rising					
	Falling					

## 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 **DQ\_FULL\_333**
    - i. T37Z Pulldown I-V model versus measurement

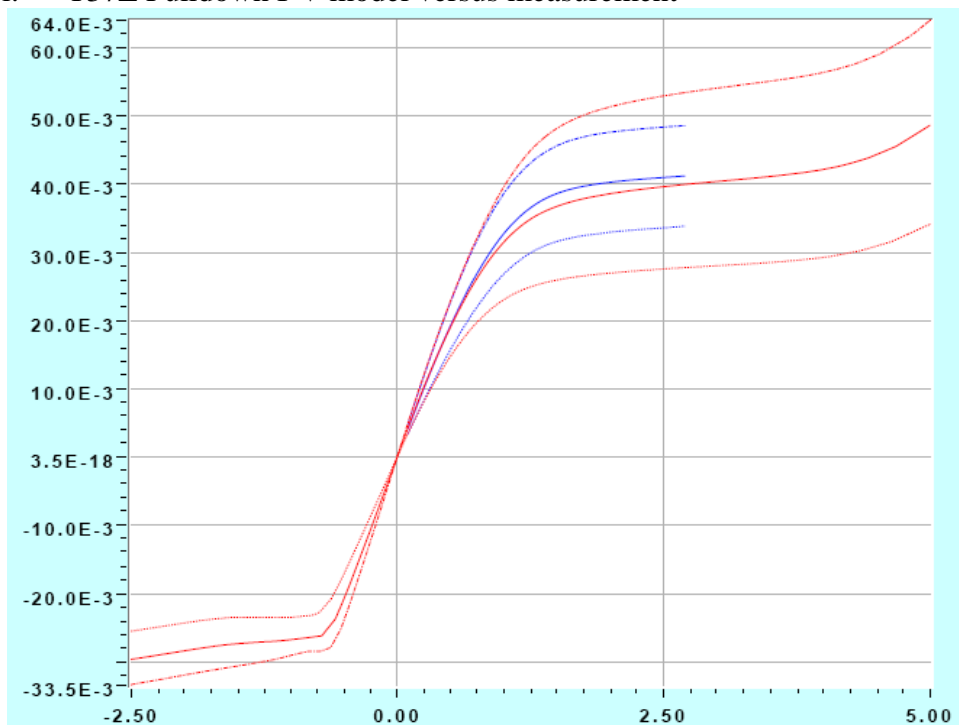


ii. T37Z Pulldown I-V model versus measurement



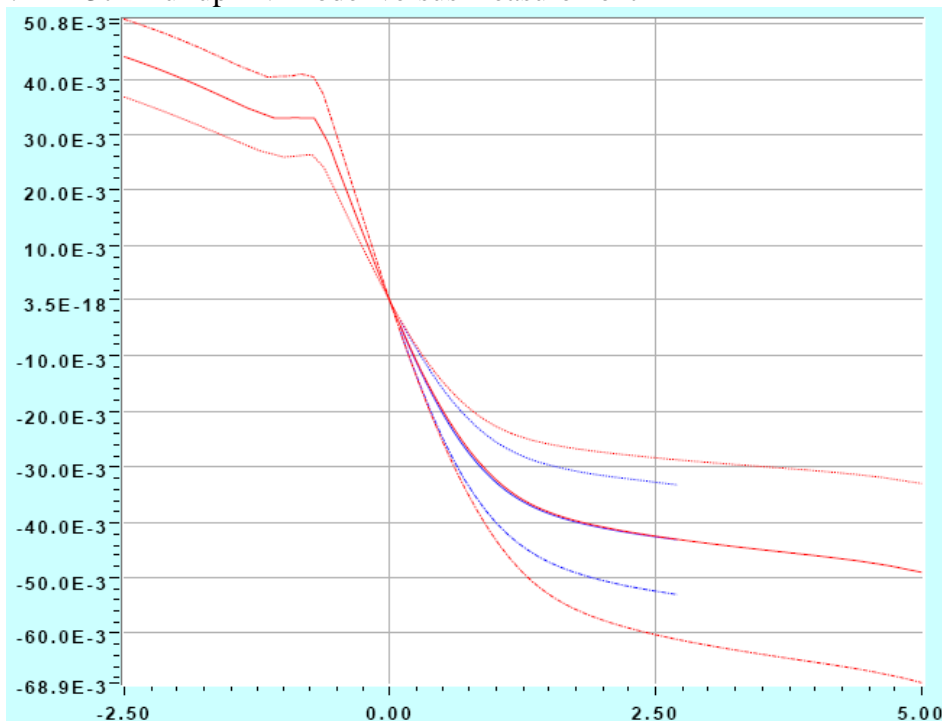
b. Model Name **DQ\_HALF\_333**

i. T37Z Pulldown I-V model versus measurement





ii. T37Z Pullup I-V model versus measurement



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 **MT46V32M16FN**

		IBIS			Measured		
		min	typ	max	min	typ	max
<b>DQ</b>	C_comp	2.850	3.000	3.150	NA	NA	NA
	C package	0.210	0.395	0.566	NA	NA	NA
	C_total	3.060	3.395	3.716	3.190	3.410	3.580
<b>DQ2</b>	C_comp	3.150	3.300	3.450	NA	NA	NA
	C package	0.419	0.437	0.447	NA	NA	NA
	C_total	3.569	3.737	3.897	3.690	3.750	3.800
<b>DM</b>	C_comp	3.700	3.850	4.000	NA	NA	NA
	C package	0.423	0.428	0.434	NA	NA	NA
	C_total	4.123	4.278	4.434	4.120	4.280	4.410
<b>INPUT</b>	C_comp	1.100	1.250	1.400	NA	NA	NA
	C package	0.400	0.489	0.618	NA	NA	NA
	C_total	1.500	1.739	2.018	1.660	1.770	1.980
<b>INPUT2</b>	C_comp	1.250	1.400	1.550	NA	NA	NA
	C package	0.407	0.407	0.407	NA	NA	NA
	C_total	1.657	1.807	1.957	1.820	1.860	1.880

<b>CLK</b>	C_comp	1.250	1.400	1.550	NA	NA	NA
	C_package	0.421	0.428	0.434	NA	NA	NA
	C_total	1.671	1.828	1.984	1.840	1.880	1.910

Insert component name here **MT46V32M16TG**

		IBIS			Measured		
		min	typ	max	min	typ	max
<b>DQ</b>	C_comp	2.850	3.000	3.150	NA	NA	NA
	C_package	1.026	1.246	1.368	NA	NA	NA
	C_total	3.876	4.246	4.518	3.950	4.240	4.440
<b>DQ2</b>	C_comp	3.150	3.300	3.450	NA	NA	NA
	C_package	0.819	0.882	0.990	NA	NA	NA
	C_total	3.969	4.182	4.440	4.060	4.170	4.330
<b>DM</b>	C_comp	3.700	3.850	4.000	NA	NA	NA
	C_package	0.927	0.932	0.936	NA	NA	NA
	C_total	4.627	4.782	4.936	4.620	4.740	4.880
<b>INPUT</b>	C_comp	1.100	1.250	1.400	NA	NA	NA
	C_package	0.999	1.245	1.386	NA	NA	NA
	C_total	2.099	2.495	2.786	2.180	2.440	2.740
<b>INPUT2</b>	C_comp	1.250	1.400	1.550	NA	NA	NA
	C_package	1.143	1.143	1.143	NA	NA	NA
	C_total	2.393	2.543	2.693	2.390	2.430	2.740
<b>CLK</b>	C_comp	1.250	1.400	1.550	NA	NA	NA
	C_package	0.963	0.977	0.990	NA	NA	NA
	C_total	2.213	2.377	2.540	2.220	2.340	2.430

3.  If measured clamp current data is available provide an IBIS and Silicon clamp comparison for all models
  - a. Model Name
    - i. Insert power-clamp comparison image
    - ii. Insert gnd-clamp comparison image
  
4.  If slew rate specifications (Rise slew and Fall slew) are available from measurements, complete HSPICE simulation to generate slew rate data and provide a comparison table.

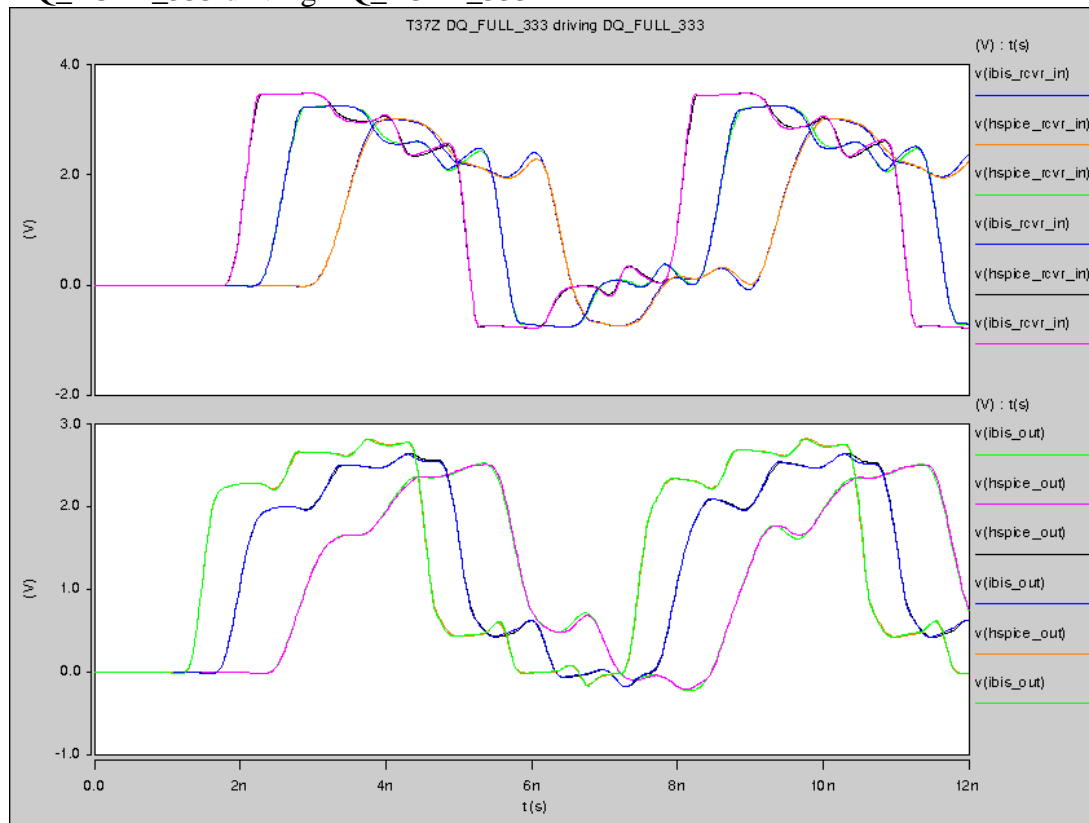
		IBIS			Datasheet	
Model	Slew Rate (V/ns)	min	typ	max	min	max
<b>DQ Full</b>	Rising					
	Falling					

DQ Half	Rising					
	Falling					

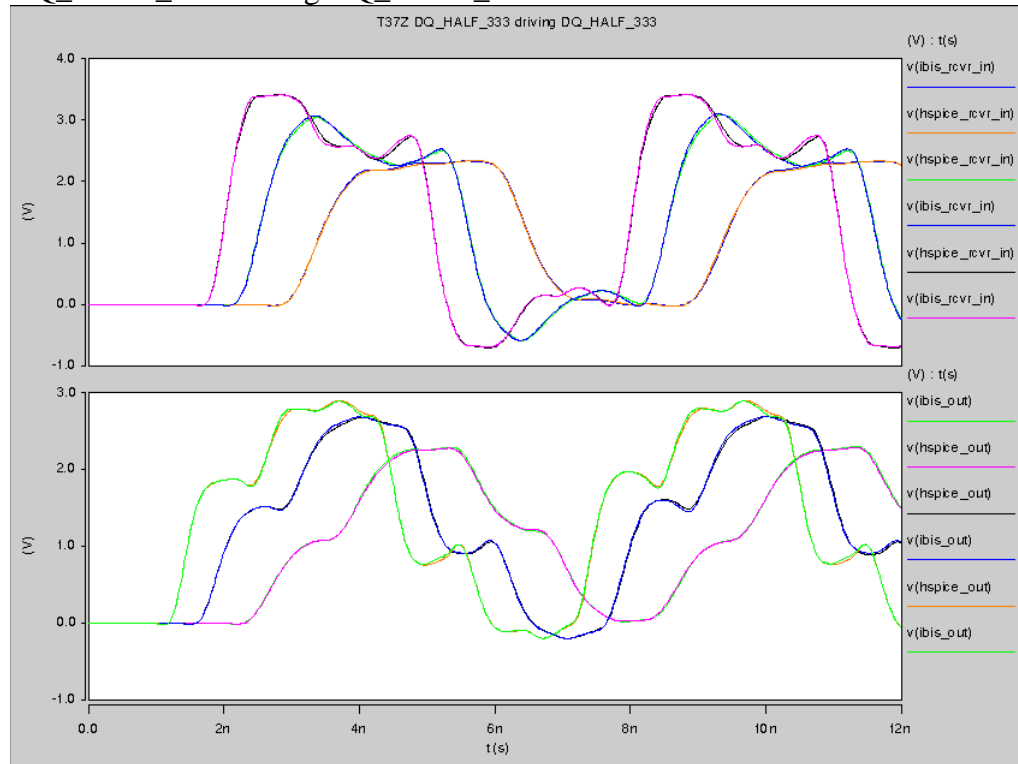
**IBIS vs HSPICE Correlation**

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: **2008.09**
  - b.  Run simulation for all corners cases and at maximum allowable speed grade

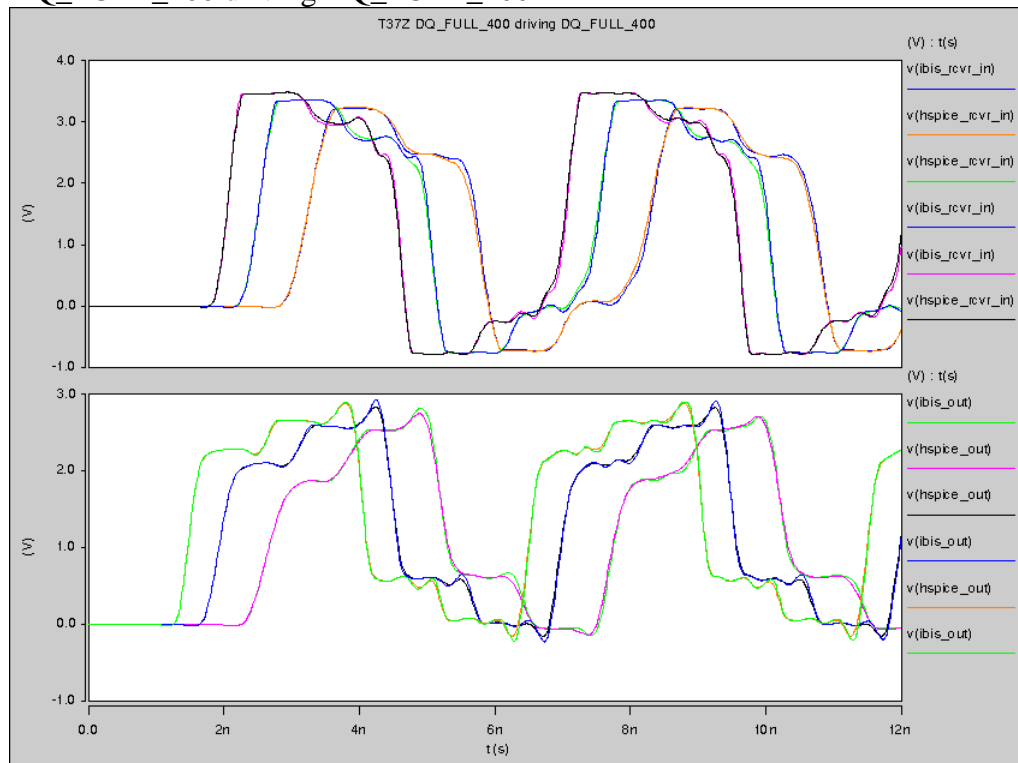
i. DQ\_FULL\_333 driving DQ\_FULL\_333



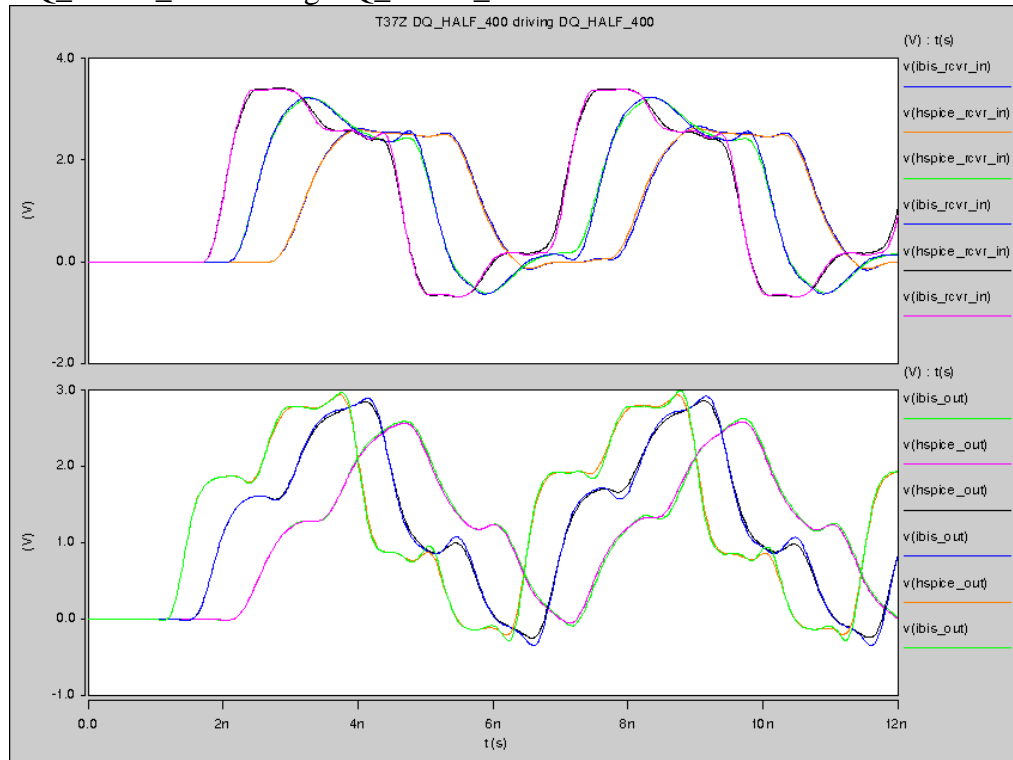
ii. DQ\_HALF\_333 driving DQ\_HALF\_333



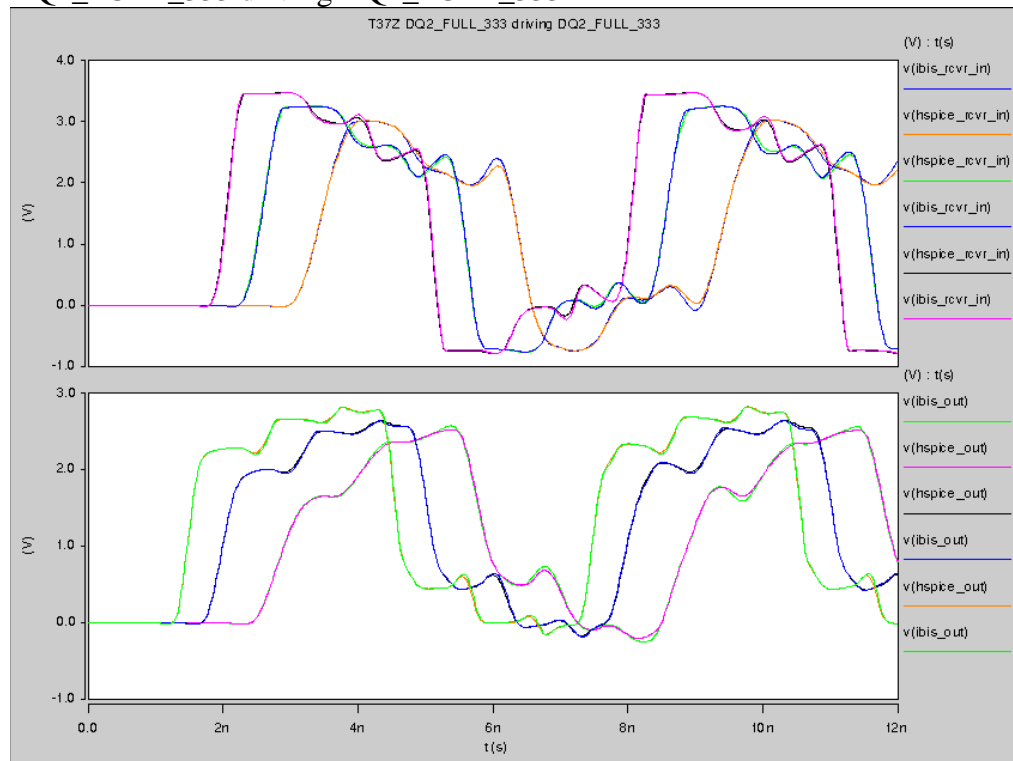
iii. DQ\_FULL\_400 driving DQ\_FULL\_400



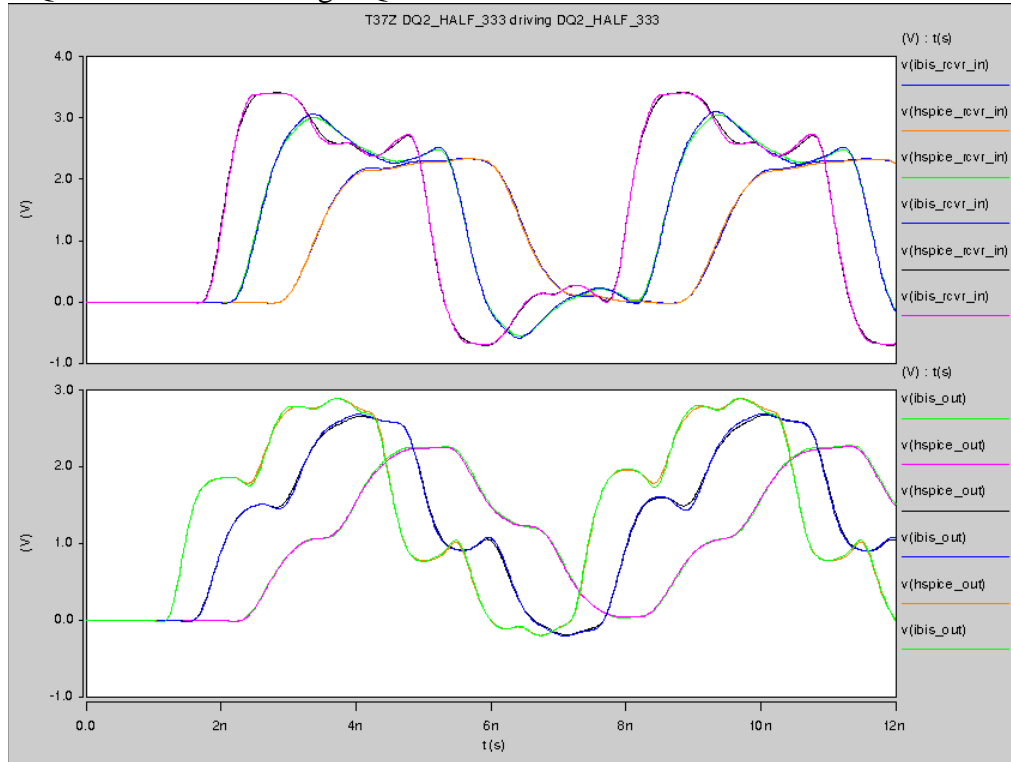
iv. DQ\_HALF\_400 driving DQ\_HALF\_400



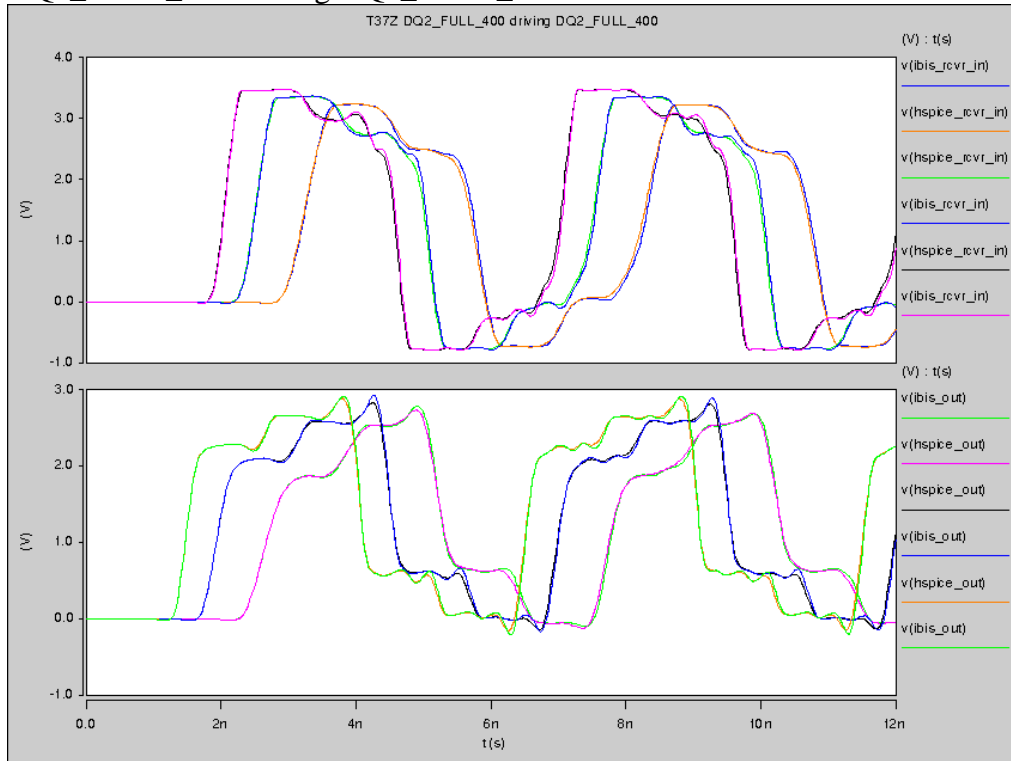
v. DQ2\_FULL\_333 driving DQ2\_FULL\_333



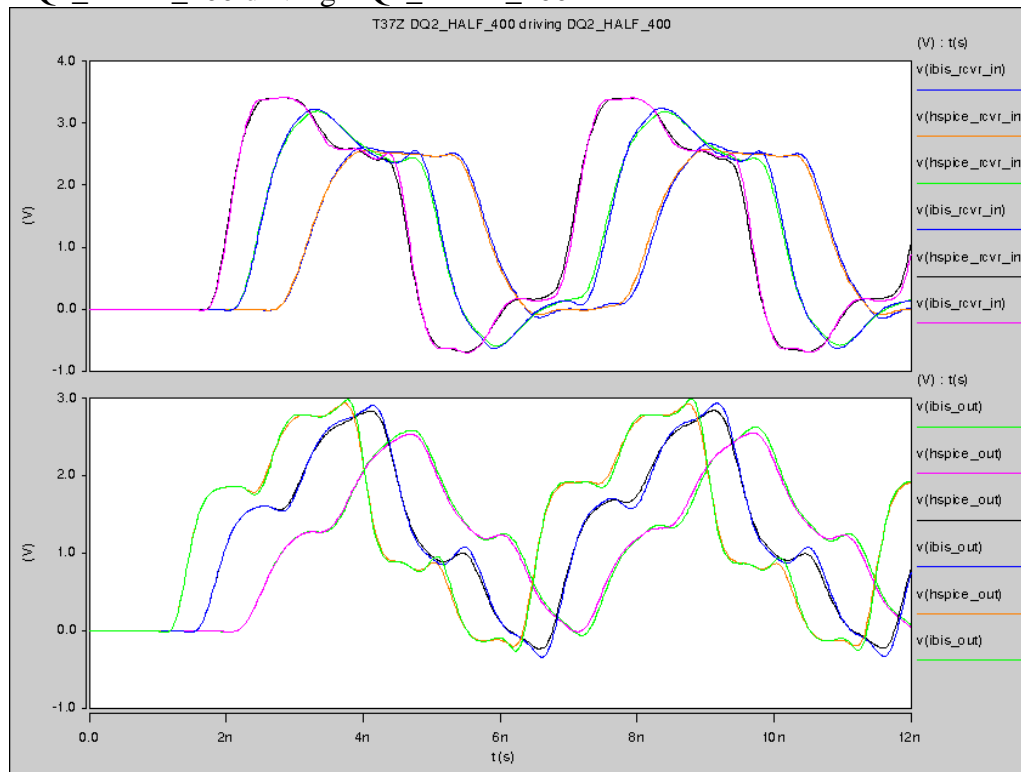
vi. DQ2\_HALF\_333 driving DQ2\_HALF\_333



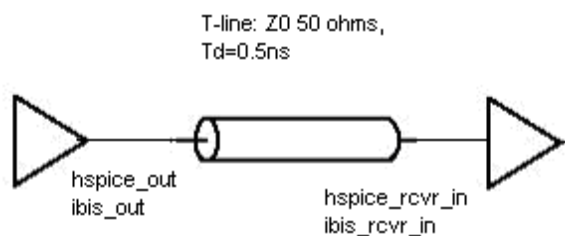
vii. DQ2\_FULL\_400 driving DQ2\_FULL\_400



viii. DQ2\_HALF\_400 driving DQ2\_HALF\_400



**Setup**



**Comments:** DQ8, LDQS and UDQS required separate DQ model (DQ2) due to higher input capacitance. A12 required separate Input model (IN2) due to higher input capacitance.

Document Revision History

Rev 1.0 – 10/22/2009

- a. IBIS revision 2.3
- b. HSPICE revision 2.3