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## **IBIS/HSPICE Model Quality Report**

**Design ID: V88A**

**Description: 1Gb 1.35V DDR3L SDRAM**

**Marketing device name(s): MT41K256M4DA, MT41K128M8DA, MT41K64M16TW, MT41K256M4V88A, MT41K128M8V88A, MT41K64M16V88A**

**Valid speed grades: DDR3-1066, DDR3-1333, DDR3-1600, DDR3-1866 <sup>1</sup>**

**Zip filename: v88a\_1p35\_ibis.zip**

**IBIS filename: v88a\_1p35.ibs, v88a\_1p35\_it.ibs File rev: 2.0**

**HSpice filename: v88a\_1p35\_hspice.zip File rev: 2.0**

**EBD filename (if applicable): File rev:**

**Die rev: J**

**Date: October 12, 2014**

**Datasheet link: [http://www.micron.com/-/media/documents/products/data%20sheet/dram/ddr3/1gb\\_1\\_35v\\_ddr3l.pdf](http://www.micron.com/-/media/documents/products/data%20sheet/dram/ddr3/1gb_1_35v_ddr3l.pdf)**

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

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### **Device Parameters**

**VDDQ – Slow: 1.283V Typical: 1.350V Fast: 1.425V**

**VDD – Slow: 1.283V Typical: 1.350V Fast: 1.425V**

**Junction Temperature (Commercial) - Slow: 110C Typical: 50C Fast: 0C**

**Junction Temperature (Industrial) - Slow: 110C Typical: 50C Fast: -40C**

**VDDQ/VSSQ Decoupling Capacitance: 11.11nF**

**Included in HSPICE DQ/DQS models? Yes Amount per DQ/DQS model: 505pF/1010pF**

**VDDQ/VSSQ Decoupling Capacitance Series Resistance: ~2ohms**

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### **IBIS Quality Summary**

1. ☒ Include the IBIS Quality Specification 2.0 Overall IBIS Quality level. For details on IBIS Quality, reference the quality specification and quality checklist on IBIS quality webpage [http://www.eda.org/pub/ibis/quality\\_wip/](http://www.eda.org/pub/ibis/quality_wip/).

**Overall IBIS Quality Level: IQ3MS**

**Exceptions: N/A**

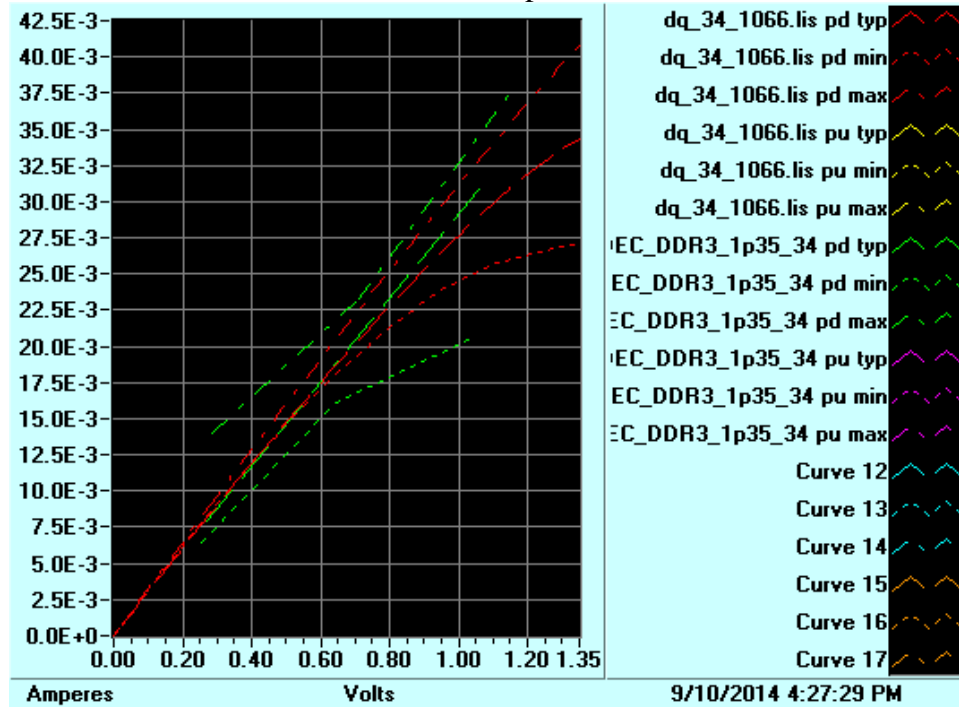
2. ☒ Include the filename of the IBIS Quality Checklist that accompanies this report.

**Filename: v88a\_1p35\_ibis\_quality\_checklist.xls**

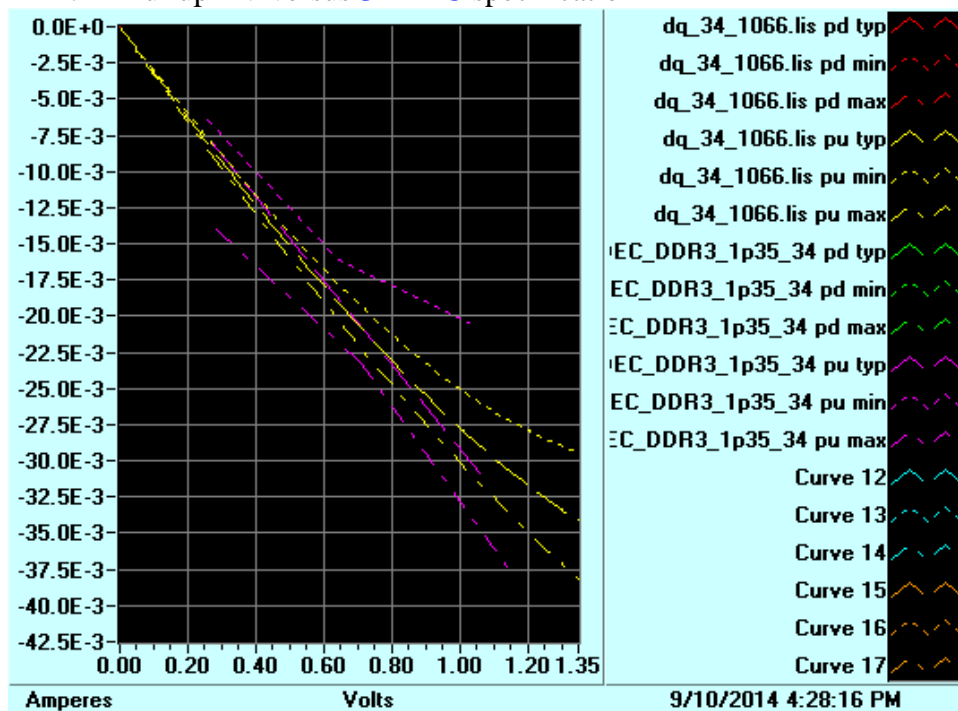
## IBIS MODEL Correlation

### Datasheet Correlation

1. ☒ For Output or I/O model compare datasheet IOH/IOL data with IBIS pullup/pulldown data.
  - a. Model name: **DQ\_34\_1066**
    - i. Pulldown I-V versus **JEDEC** specification

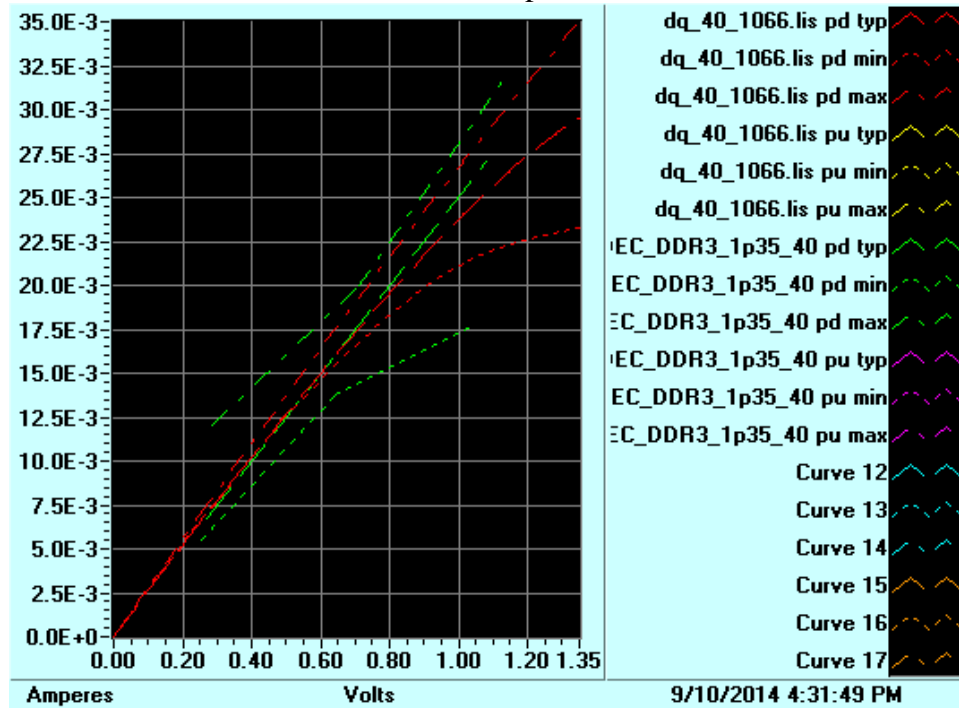


ii. Pullup I-V versus JEDEC specification

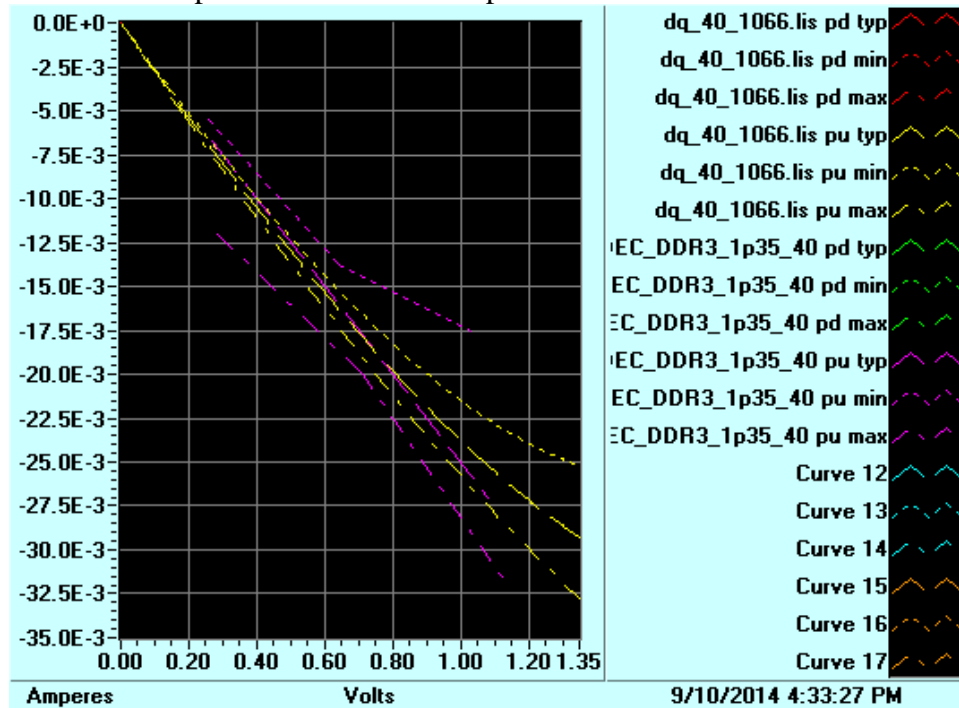


b. Model name: **DQ\_40\_1066**

i. Pulldown I-V versus **JEDEC** specification



ii. Pullup I-V versus **JEDEC** 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).<sup>3</sup>

Component name: **MT41K256M4DA, MT41K128M8DA (78b, x4/x8)**

		IBIS (pF)		Datasheet (pF)	
		min	max	min	max
<b>DQ</b>	C_comp	1.225	1.375	NA	NA
	C package	0.378	0.556	NA	NA
	C_total	1.603	1.931	1.40	2.20
<b>INPUT1</b>	C_comp	0.635	0.785	NA	NA
	C package	0.362	0.447	NA	NA
	C_total	0.997	1.232	0.75	1.20
<b>INPUT2</b>	C_comp	0.675	0.825	NA	NA
	C package	0.268	0.366	NA	NA
	C_total	0.943	1.191	0.75	1.20
<b>CLK</b>	C_comp	0.625	0.775	NA	NA
	C package	0.332	0.357	NA	NA
	C_total	0.957	1.132	0.80	1.40
<b>RST</b>	C_comp	0.635	0.785	NA	NA
	C package	0.496	0.496	NA	NA
	C_total	1.131	1.281	NA	3.00

Component name: **MT41K64M16TW (96b, x16)**

		IBIS (pF)		Datasheet (pF)	
		min	max	min	max
<b>DQ</b>	C_comp	1.225	1.375	NA	NA
	C package	0.335	0.485	NA	NA
	C_total	1.560	1.860	1.40	2.20
<b>INPUT1</b>	C_comp	0.635	0.785	NA	NA
	C package	0.388	0.476	NA	NA
	C_total	1.023	1.261	0.75	1.20
<b>INPUT2</b>	C_comp	0.675	0.825	NA	NA
	C package	0.322	0.416	NA	NA
	C_total	0.997	1.241	0.75	1.20
<b>CLK</b>	C_comp	0.625	0.775	NA	NA
	C package	0.320	0.323	NA	NA
	C_total	0.945	1.098	0.80	1.40
<b>RST</b>	C_comp	0.635	0.785	NA	NA
	C package	0.517	0.517	NA	NA
	C_total	1.152	1.302	NA	3.00

3. ☒ If slew rate specifications (rise/fall slew) are available from the datasheet, complete HSpice simulations to generate slew rate data and provide a comparison table.<sup>4</sup>

Model	Slew Rate (V/ns)	IBIS			Datasheet	
		min	typ	max	min	max
DQ_34_1066	Rising	7.30	3.64	5.42	1.75	6.00
	Falling	6.84	3.78	5.37	1.75	6.00
DQ_40_1066	Rising	6.53	3.13	4.78	1.75	6.00
	Falling	6.22	3.27	4.76	1.75	6.00
DQ_34_1600	Rising	7.16	3.64	5.34	1.75	6.00
	Falling	6.69	3.75	5.31	1.75	6.00
DQ_40_1600	Rising	6.38	3.11	4.76	1.75	6.00
	Falling	6.12	3.09	4.71	1.75	6.00
DQ_34_1866	Rising	7.31	4.21	5.44	1.75	6.00
	Falling	6.88	4.10	5.37	1.75	6.00
DQ_40_1866	Rising	6.55	3.65	4.78	1.75	6.00
	Falling	6.24	3.59	4.77	1.75	6.00

4. ☒ Compare ODT data with datasheet.

ODT calculated using the formula  $RTT = (V_{IH(ac)} - V_{IL(ac)}) / (I(V_{IH(ac)}) - I(V_{IL(ac)}))$

ODT20	TYP	MIN	MAX
Vil (V)	0.515	0.4815	0.5525
Vih (V)	0.835	0.8015	0.8725
Ivil (A)	-7.54E-03	-6.13E-03	-7.75E-03
Ivih (A)	6.98E-03	6.46E-03	8.41E-03
	TYP	MAX	MIN
Rtt (Model)	22.04	25.42	19.80
Rtt (datasheet-in units of ZQ/12)	1.0	1.6	0.9
Rtt (datasheet)	20	32	18

ODT30	TYP	MIN	MAX
Vil (V)	0.515	0.4815	0.5525
Vih (V)	0.835	0.8015	0.8725
Ivil (A)	-5.01E-03	-4.13E-03	-5.16E-03
Ivih (A)	4.64E-03	4.35E-03	5.61E-03
	TYP	MAX	MIN
Rtt (Model)	33.16	37.73	29.71
Rtt (datasheet-in units of ZQ/12)	1.0	1.6	0.9
Rtt (datasheet)	30	48	27

ODT40	TYP	MIN	MAX
Vil (V)	0.515	0.4815	0.5525
Vih (V)	0.835	0.8015	0.8725
Ivil (A)	-3.75E-03	-3.10E-03	-3.89E-03
Ivih (A)	3.47E-03	3.26E-03	4.21E-03
	TYP	MAX	MIN
Rtt (Model)	44.30	50.29	39.47
Rtt (datasheet-in units of ZQ/12)	1.0	1.6	0.9
Rtt (datasheet)	40	64	36

ODT60	TYP	MIN	MAX
Vil (V)	0.515	0.4815	0.5525
Vih (V)	0.835	0.8015	0.8725
Ivil (A)	-2.52E-03	-2.07E-03	-2.59E-03
Ivih (A)	2.33E-03	2.17E-03	2.81E-03
	TYP	MAX	MIN
Rtt (Model)	66.06	75.43	59.34
Rtt (datasheet-in units of ZQ/12)	1.0	1.6	0.9
Rtt (datasheet)	60	96	54

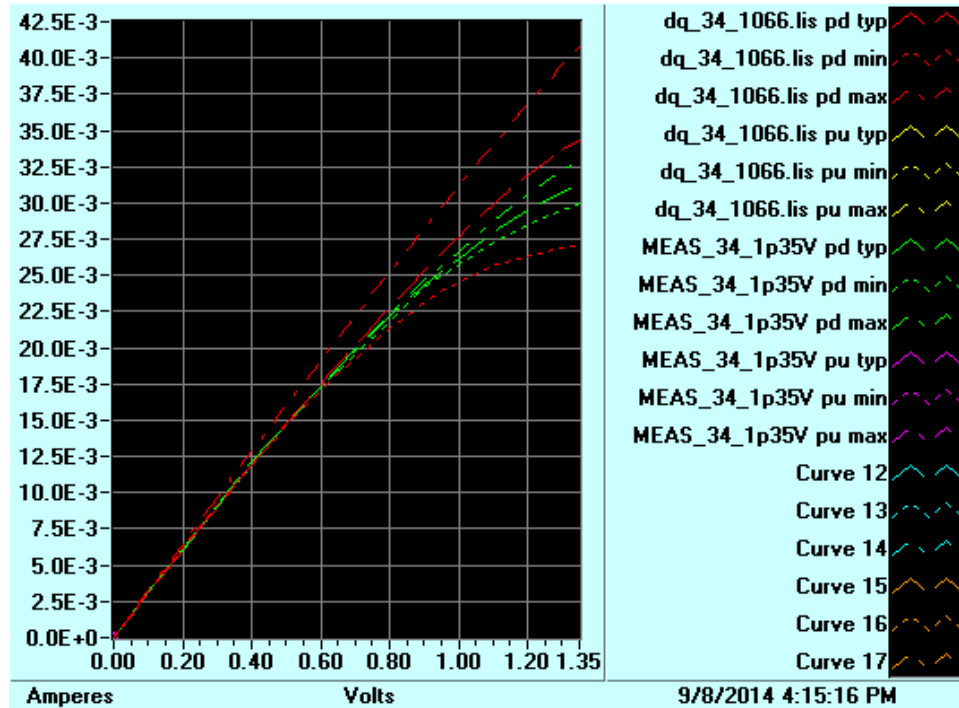
ODT120	TYP	MIN	MAX
Vil (V)	0.515	0.4815	0.5525
Vih (V)	0.835	0.8015	0.8725
Ivil (A)	-1.26E-03	-1.04E-03	-1.30E-03
Ivih (A)	1.16E-03	1.09E-03	1.41E-03
	TYP	MAX	MIN
Rtt (Model)	132.14	150.85	118.13
Rtt (datasheet-in units of ZQ/12)	1.0	1.6	0.9
Rtt (datasheet)	120	192	108

## Measurement Correlation

1. ☒ For Output or I/O models compare measured IOH/IOL data with IBIS pullup/pulldown data. If the measurement conditions are different than the IBIS conditions, run Spice simulations using the same measurement conditions such as VCC, temperature, and process. Include measurement conditions in the image labels.

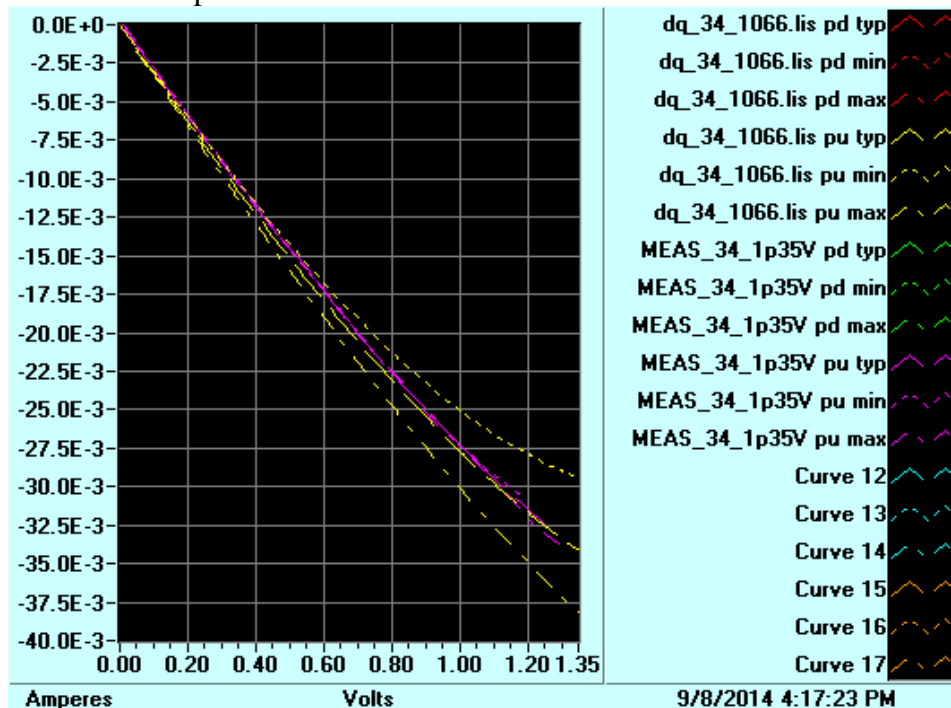
a. Model name: **DQ\_34\_1066**

i. Pulldown I-V versus Measurement



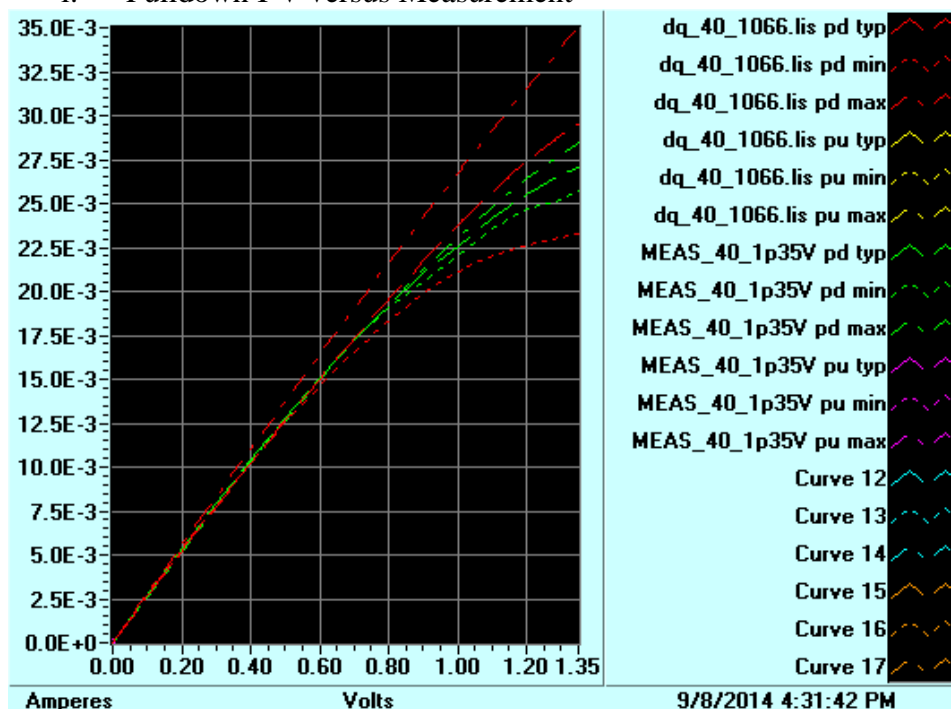


ii. Pullup I-V versus Measurement

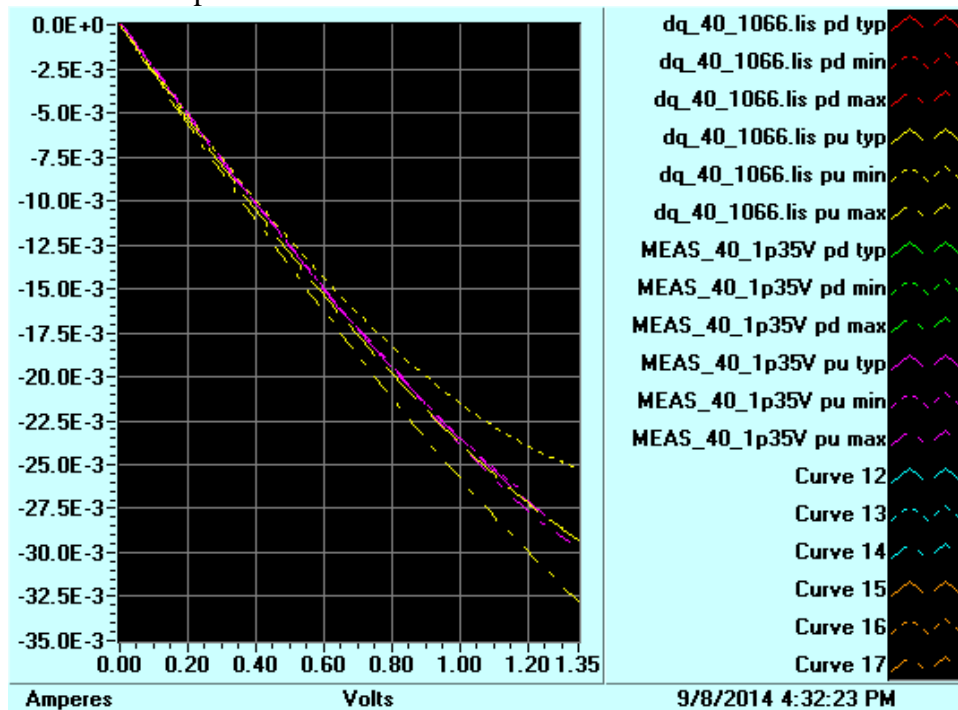


b. Model name: **DQ\_40\_1066**

i. Pulldown I-V versus Measurement



ii. Pullup I-V versus Measurement



2. ☒ Compare C<sub>comp</sub> with measured C<sub>comp</sub>. Provide C<sub>comp</sub> comparison table for all models and for all package combinations (i.e x4, x8 and x16).

Component name: **MT41K256M4DA, MT41K128M8DA (78b, x4/x8)**

		IBIS (pF)			Measured (pF)		
		min	typ	max	min	typ	max
<b>DQ</b>	C <sub>comp</sub>	1.225	1.300	1.375	NA	NA	NA
	C package	0.378	0.445	0.556	NA	NA	NA
	C <sub>total</sub>	1.603	1.745	1.931	1.680	1.760	1.880
<b>INPUT1</b>	C <sub>comp</sub>	0.635	0.710	0.785	NA	NA	NA
	C package	0.362	0.406	0.447	NA	NA	NA
	C <sub>total</sub>	0.997	1.116	1.232	1.040	1.109	1.170
<b>INPUT2</b>	C <sub>comp</sub>	0.675	0.750	0.825	NA	NA	NA
	C package	0.268	0.327	0.366	NA	NA	NA
	C <sub>total</sub>	0.943	1.077	1.191	1.030	1.085	1.150
<b>CLK</b>	C <sub>comp</sub>	0.625	0.700	0.775	NA	NA	NA
	C package	0.332	0.345	0.357	NA	NA	NA
	C <sub>total</sub>	0.957	1.045	1.132	1.040	1.050	1.060
<b>RST</b>	C <sub>comp</sub>	0.635	0.710	0.785	NA	NA	NA
	C package	0.496	0.496	0.496	NA	NA	NA
	C <sub>total</sub>	1.131	1.206	1.281	1.170	1.180	1.190

Component name: **MT41K64M16TW (96b, x16)**

		IBIS (pF)			Measured (pF)		
		min	typ	max	min	typ	max
<b>DQ</b>	C <sub>comp</sub>	1.225	1.300	1.375	NA	NA	NA
	C package	0.335	0.404	0.485	NA	NA	NA
	C <sub>total</sub>	1.560	1.704	1.860	1.620	1.700	1.840
<b>INPUT1</b>	C <sub>comp</sub>	0.635	0.710	0.785	NA	NA	NA
	C package	0.388	0.432	0.476	NA	NA	NA
	C <sub>total</sub>	1.023	1.142	1.261	1.060	1.140	1.230
<b>INPUT2</b>	C <sub>comp</sub>	0.675	0.750	0.825	NA	NA	NA
	C package	0.322	0.360	0.416	NA	NA	NA
	C <sub>total</sub>	0.997	1.110	1.241	1.040	1.110	1.200
<b>CLK</b>	C <sub>comp</sub>	0.625	0.700	0.775	NA	NA	NA
	C package	0.320	0.322	0.323	NA	NA	NA
	C <sub>total</sub>	0.945	1.022	1.098	0.970	0.990	1.000
<b>RST</b>	C <sub>comp</sub>	0.635	0.710	0.785	NA	NA	NA
	C package	0.517	0.517	0.517	NA	NA	NA
	C <sub>total</sub>	1.152	1.227	1.302	1.240	1.250	1.260

- 
3. ☐ If measured clamp current data is available, provide an IBIS versus measurement comparison for all models. Include measurement conditions in the image labels.

**Not Available**

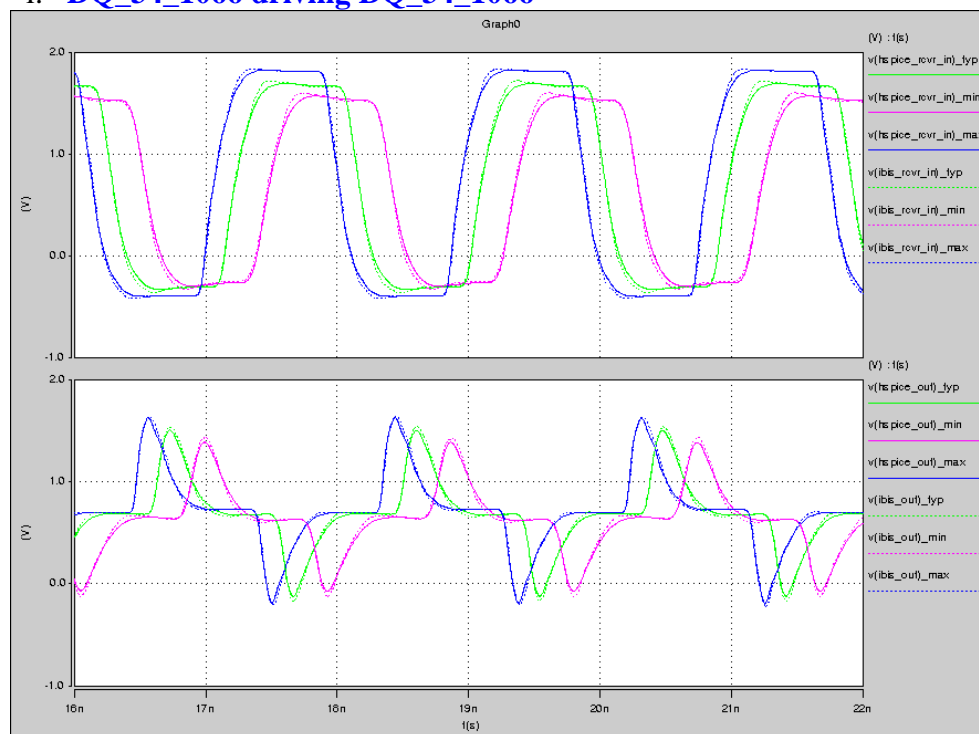
4. ☐ If slew rate data (rise/fall slew) is available from measurements, complete Spice simulations to generate slew rate data and provide a comparison table.

**Not Available**

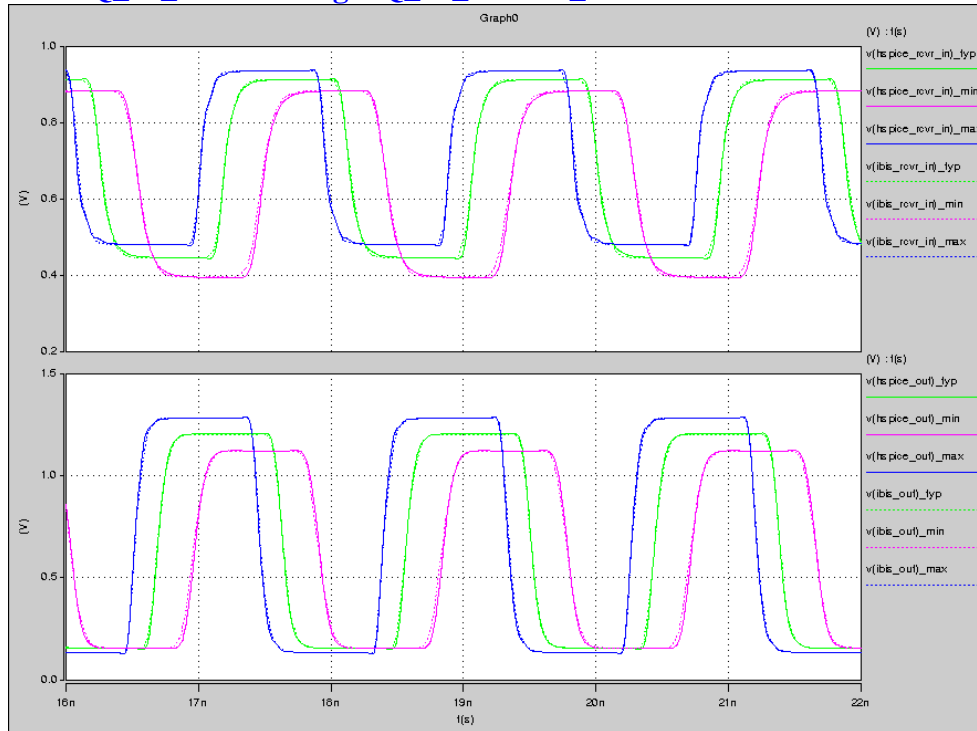
## IBIS vs Spice Correlation

1. ☒ For all Output or I/O models, run Spice transient simulations using encrypted netlists and the IBIS model (b-element).
  - a. ☒ Use the setup and node naming conventions shown below for the IBIS and Spice files. Update the setup diagram if it is different. Indicate the version of Spice simulator used for simulations: **2012.06**
  - b. ☒ Run simulations for all corners cases and at fastest speed grades, testing ODT models as loads when applicable.

### i. DQ\_34\_1066 driving DQ\_34\_1066

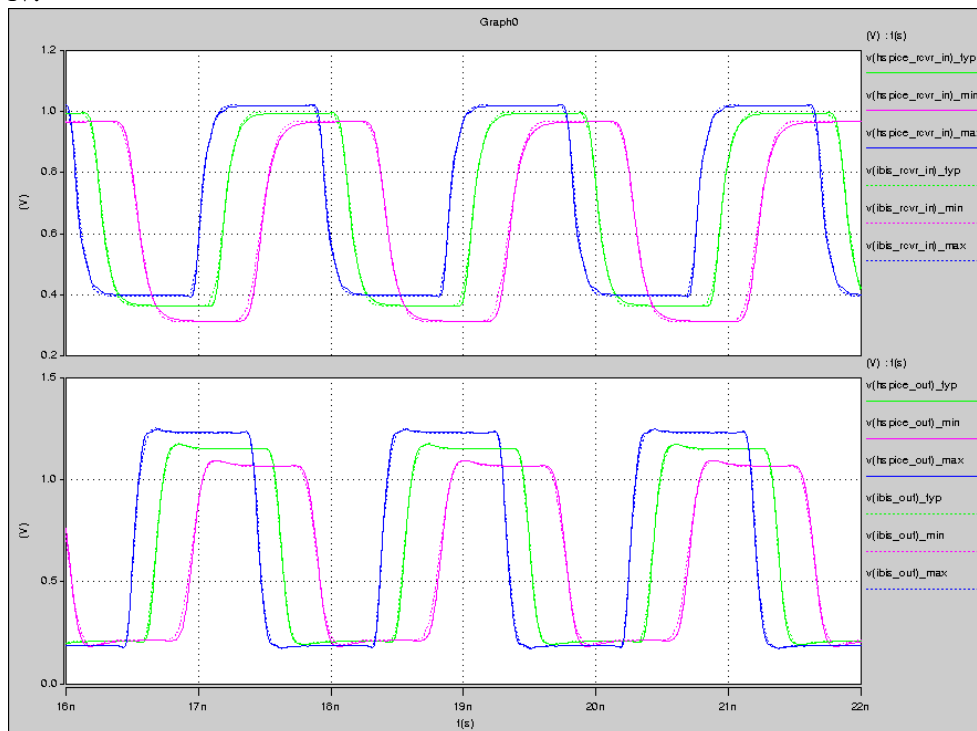


ii. **DQ\_34\_1066 driving DQ\_34\_ODT20\_1066**

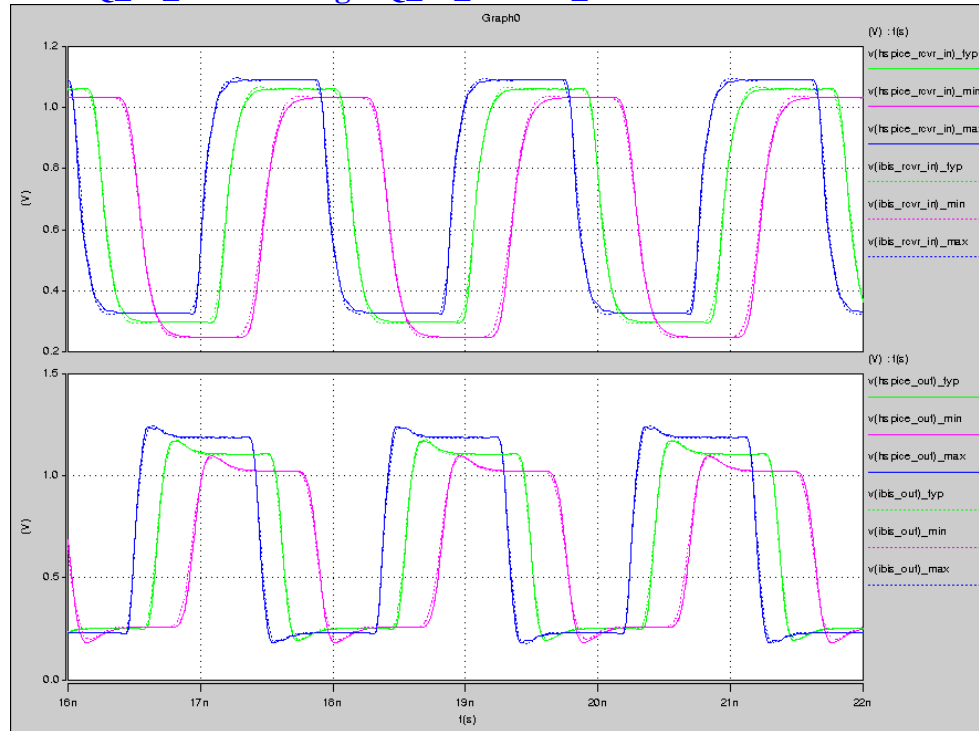


iii. **DQ\_34\_1066 driving DQ\_34\_ODT30\_1066**

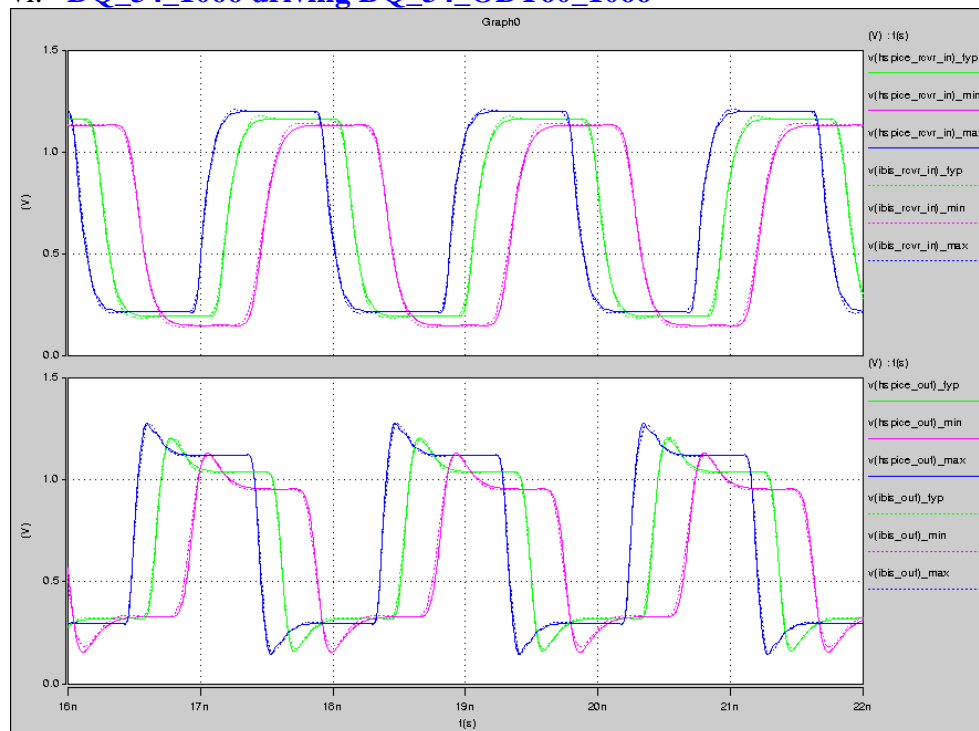
iv.



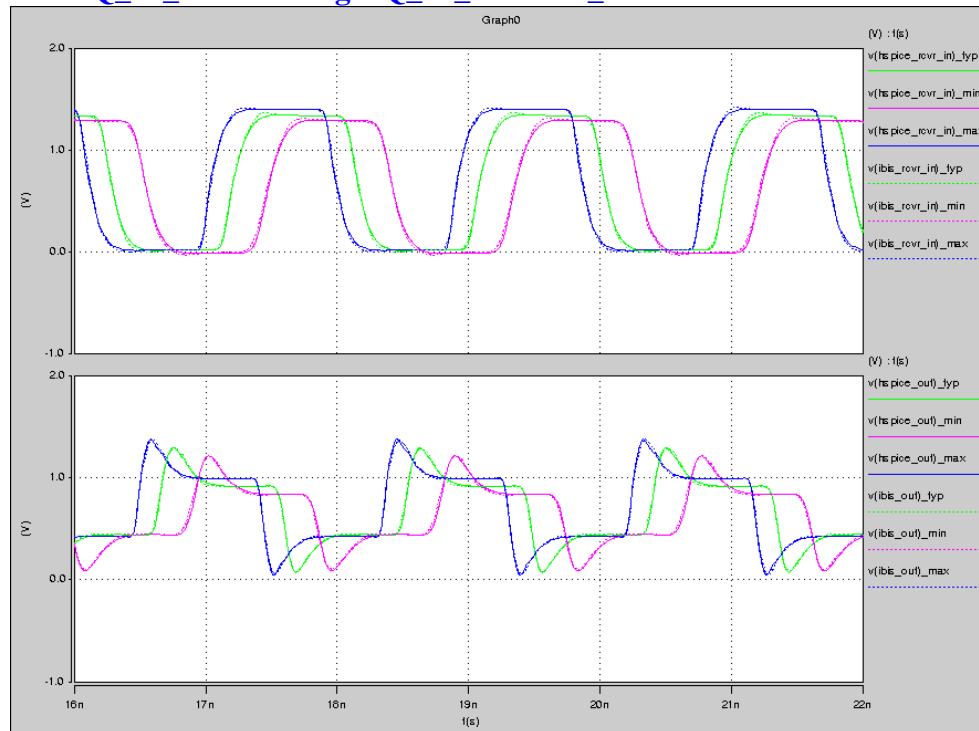
v. **DQ\_34\_1066 driving DQ\_34\_ODT40\_1066**



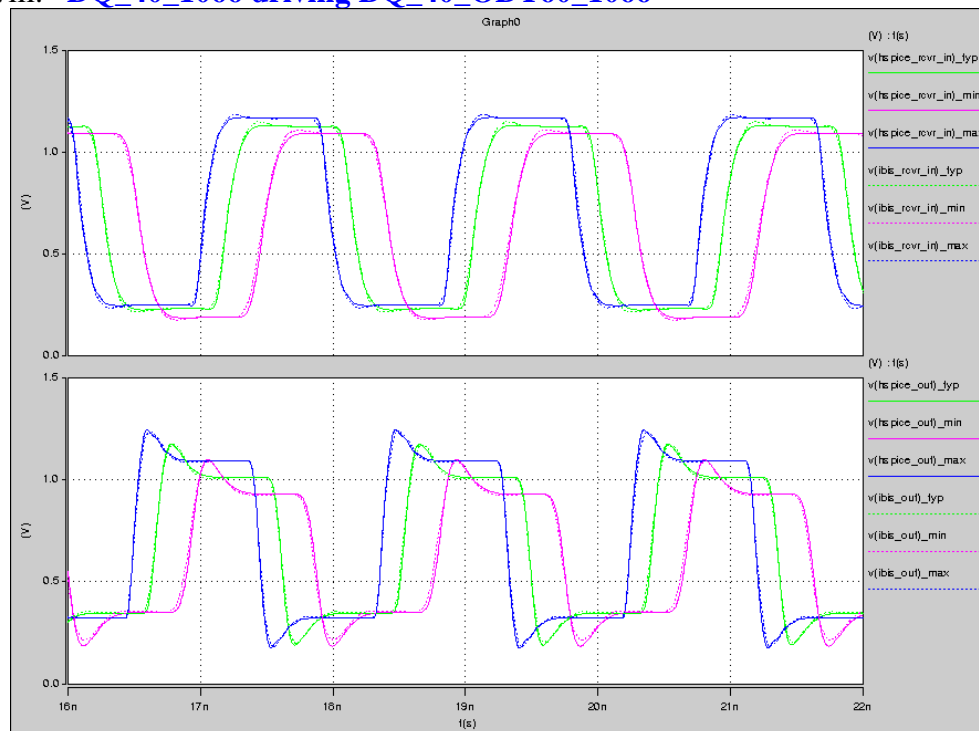
vi. **DQ\_34\_1066 driving DQ\_34\_ODT60\_1066**



vii. **DQ\_34\_1066 driving DQ\_34\_ODT120\_1066**

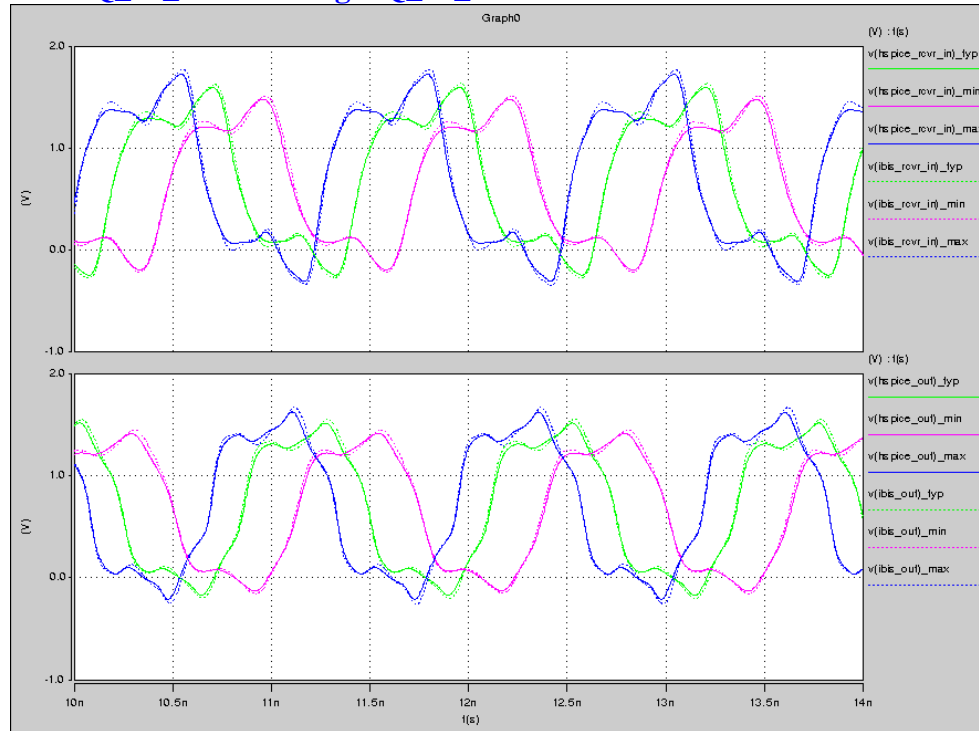


viii. **DQ\_40\_1066 driving DQ\_40\_ODT60\_1066**

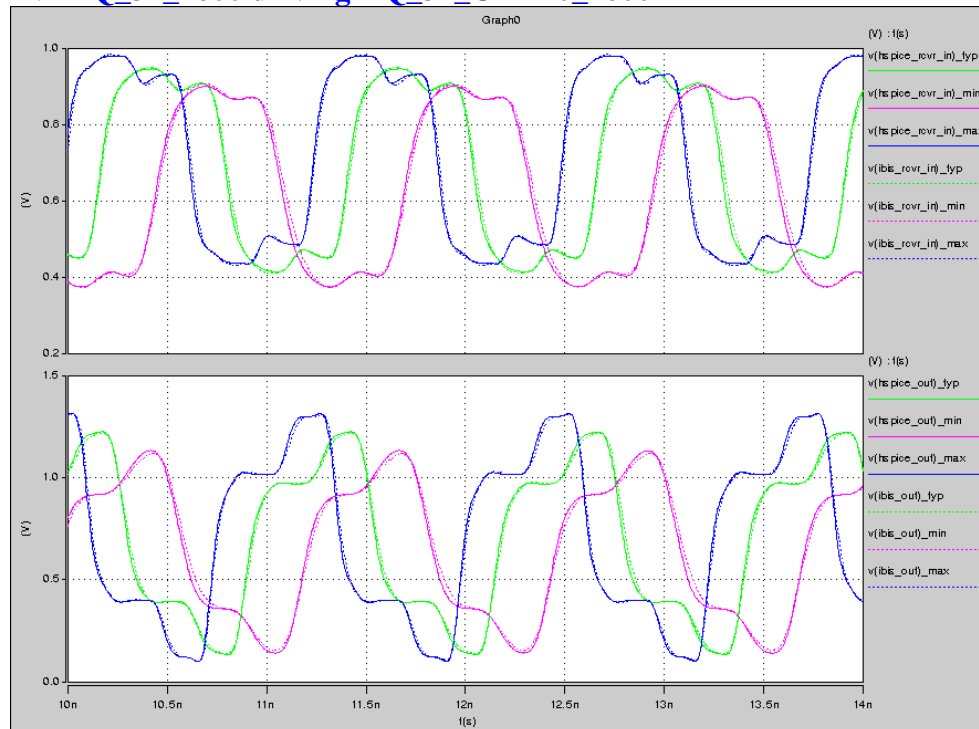




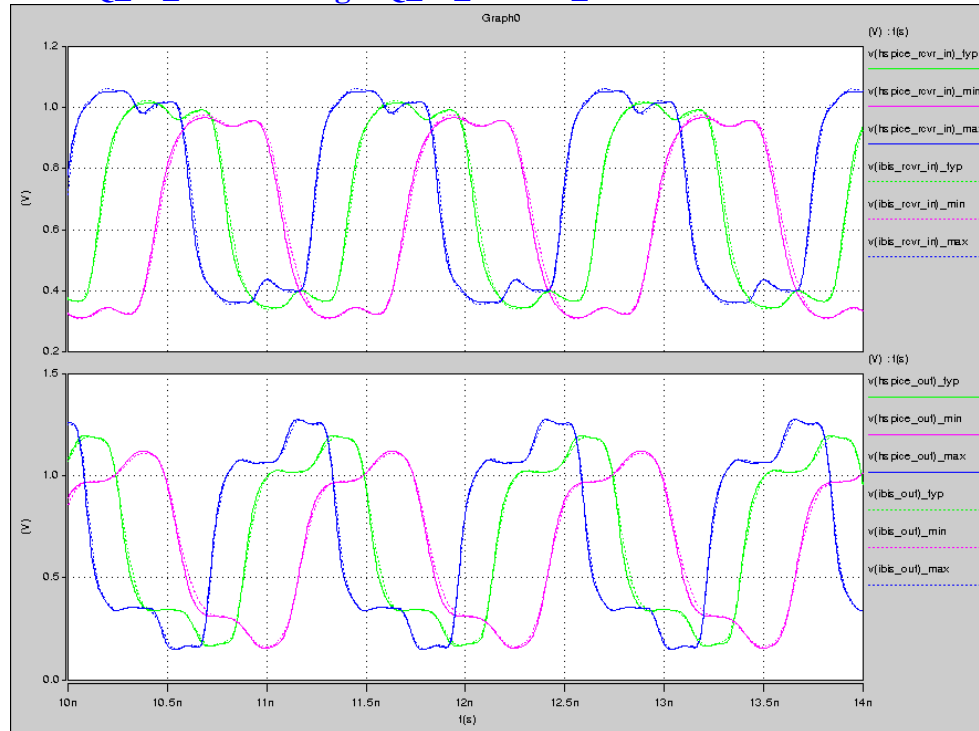
### ix. DQ\_34\_1600 driving DQ\_34\_1600



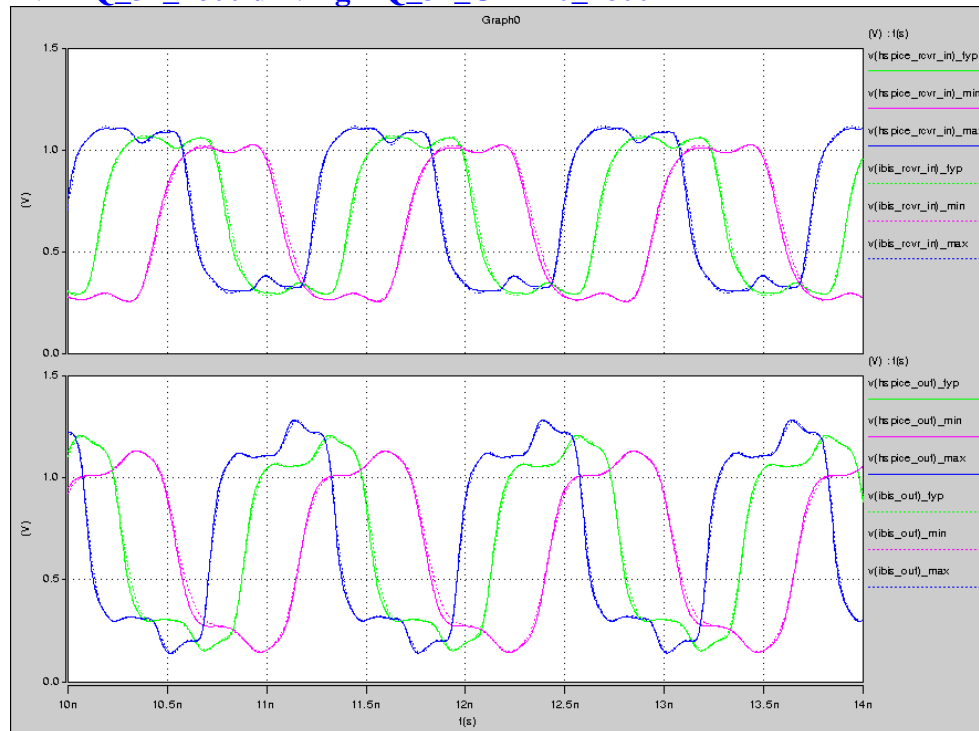
### x. DQ\_34\_1600 driving DQ\_34\_ODT20\_1600



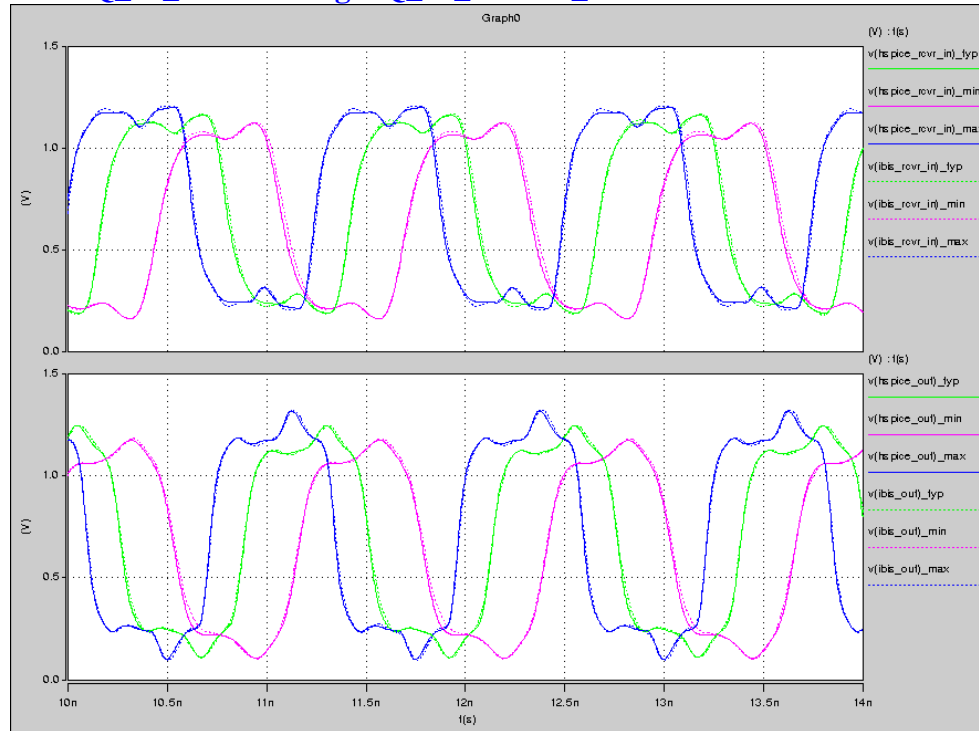
xi. **DQ\_34\_1600 driving DQ\_34\_ODT30\_1600**



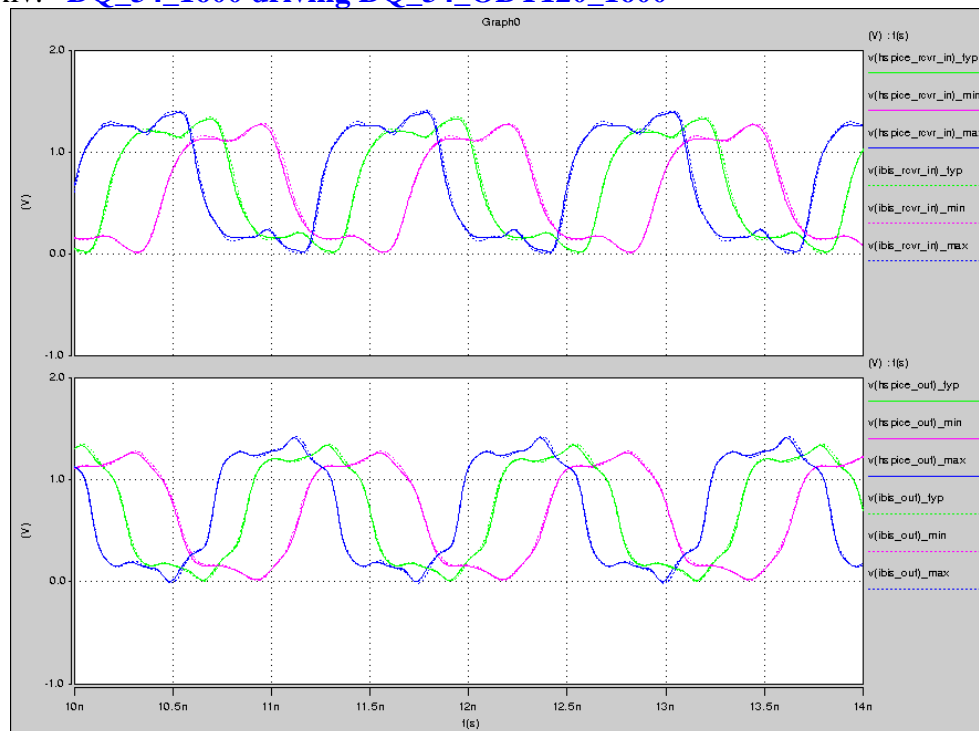
xii. **DQ\_34\_1600 driving DQ\_34\_ODT40\_1600**



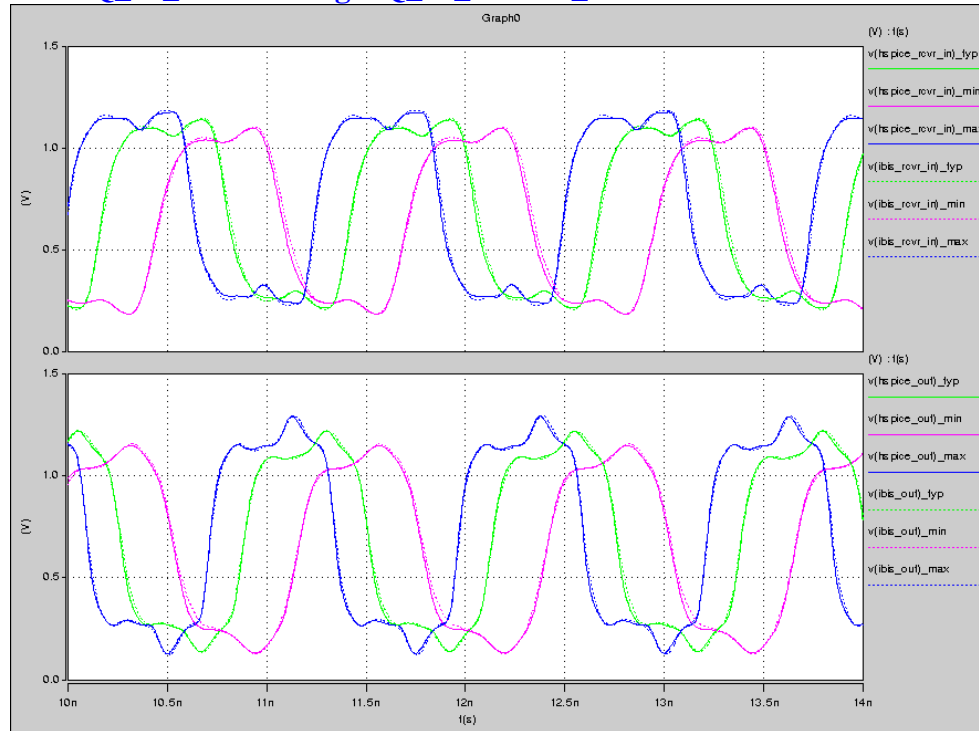
xiii. **DQ\_34\_1600 driving DQ\_34\_ODT60\_1600**



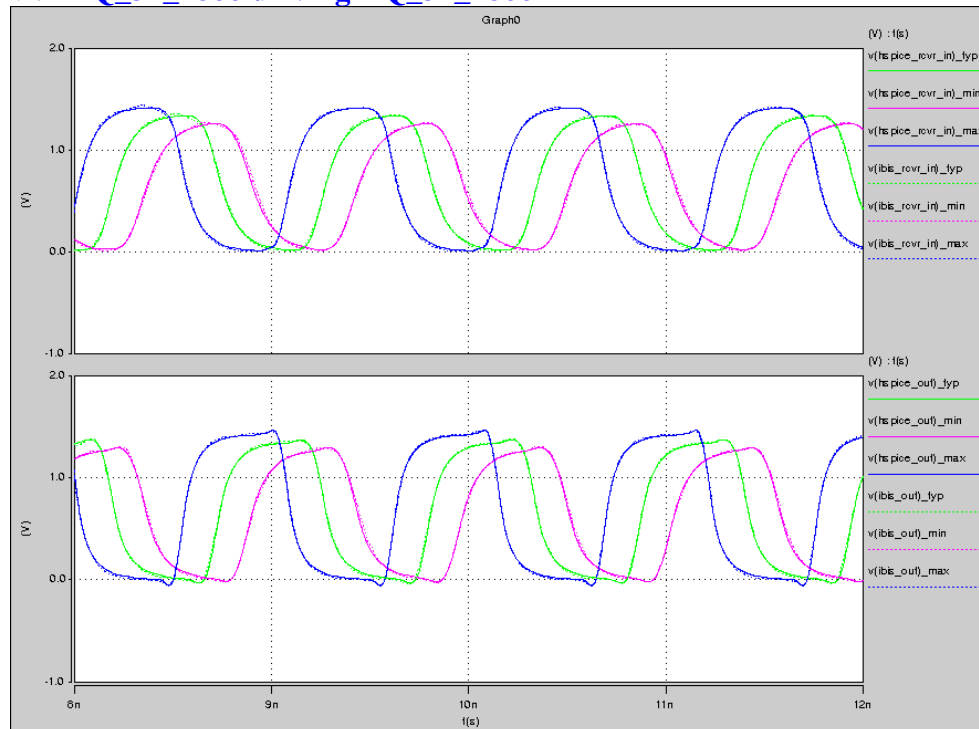
xiv. **DQ\_34\_1600 driving DQ\_34\_ODT120\_1600**



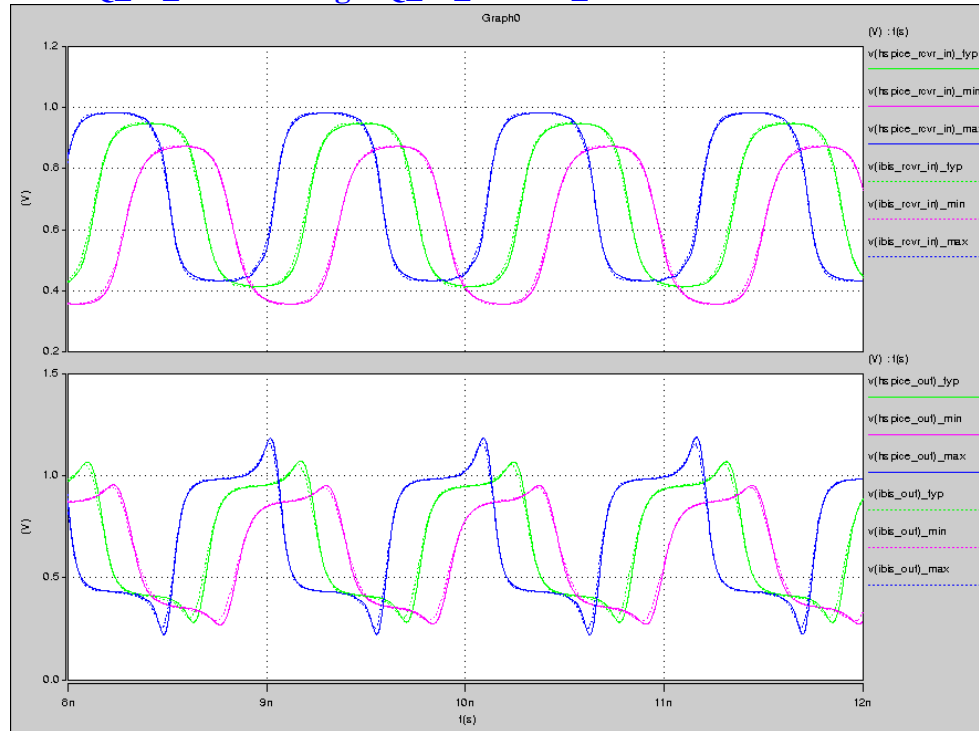
xv. **DQ\_40\_1600 driving DQ\_40\_ODT60\_1600**



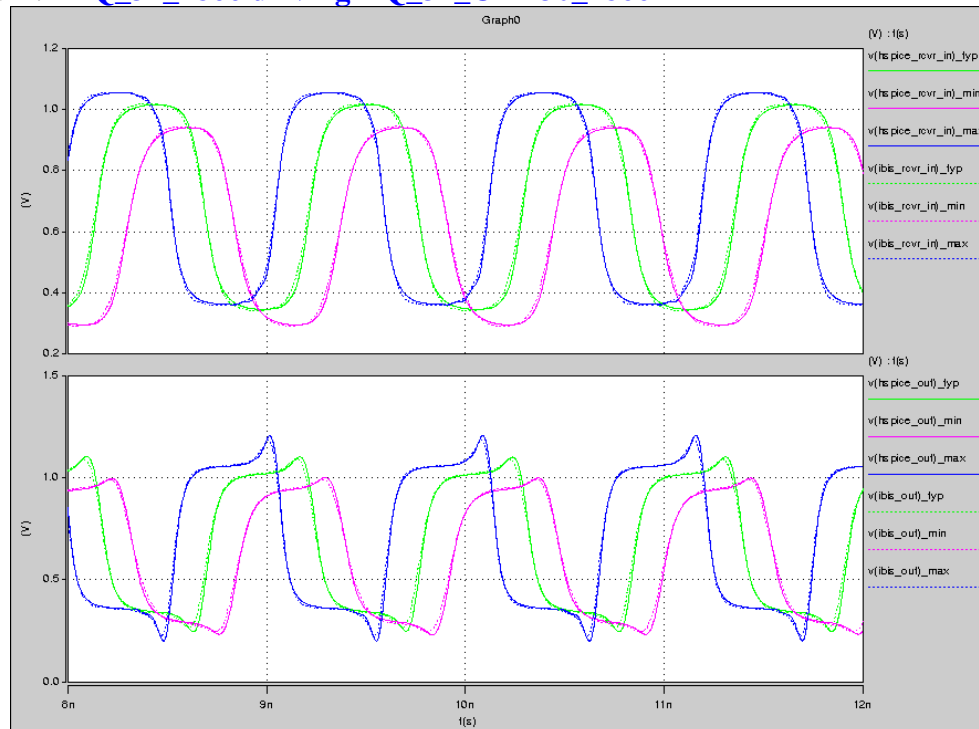
xvi. **DQ\_34\_1866 driving DQ\_34\_1866**



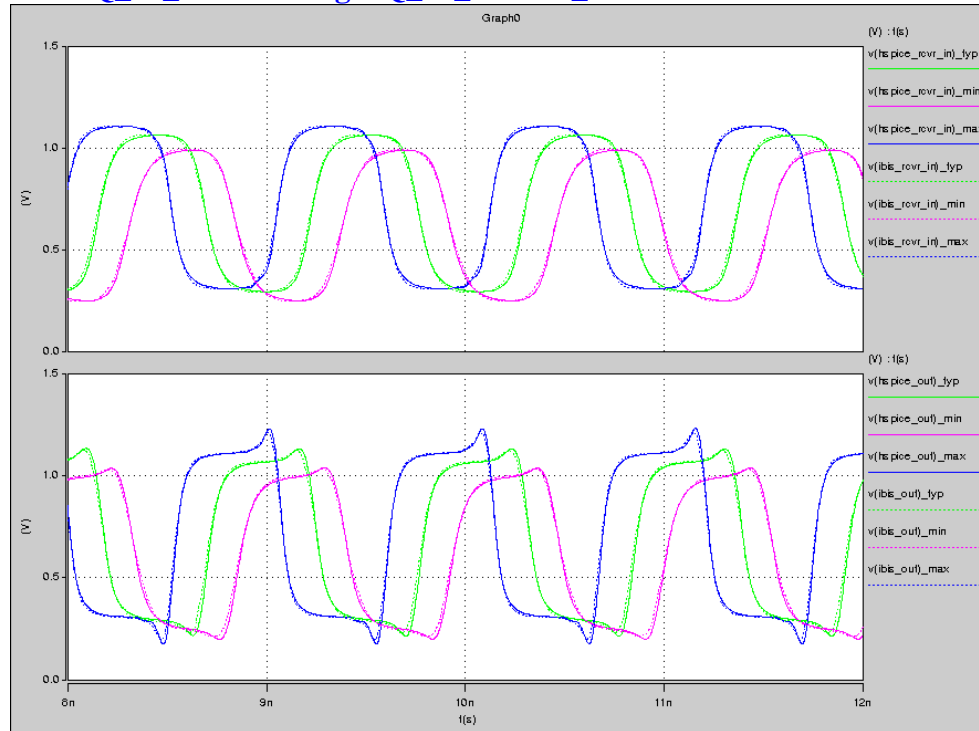
xvii. **DQ\_34\_1866 driving DQ\_34\_ODT20\_1866**



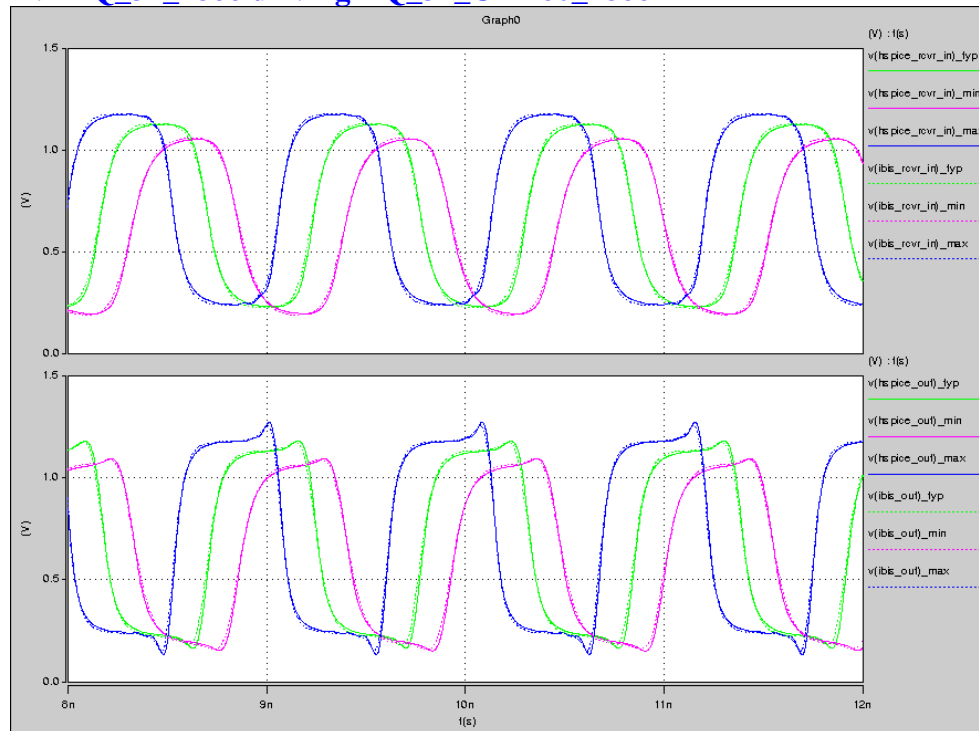
xviii. **DQ\_34\_1866 driving DQ\_34\_ODT30\_1866**



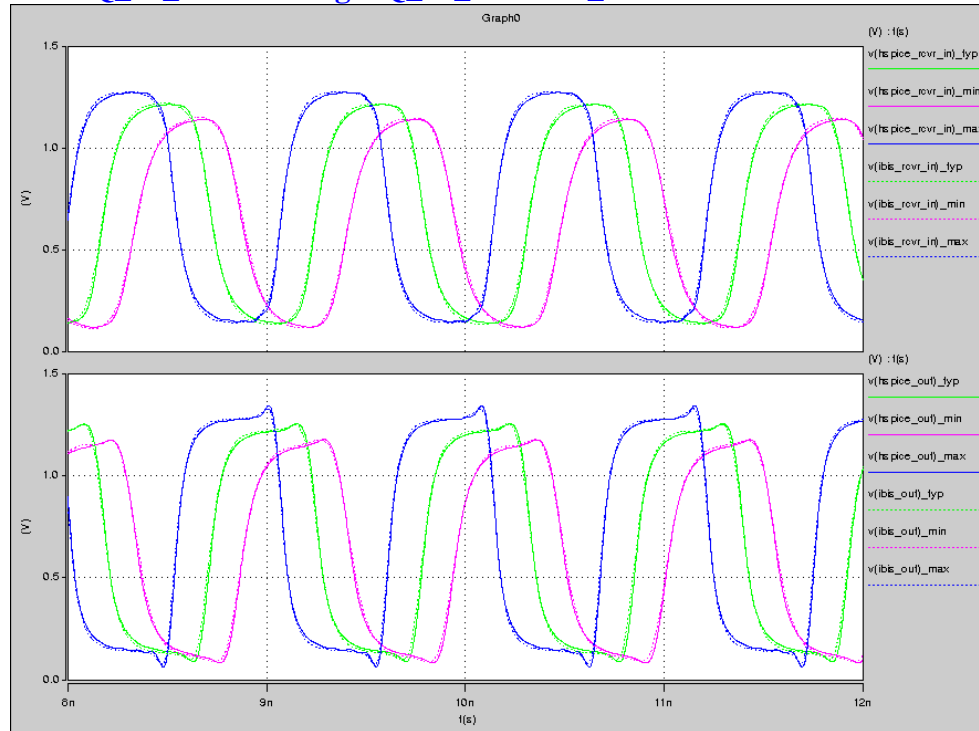
xix. **DQ\_34\_1866 driving DQ\_34\_ODT40\_1866**



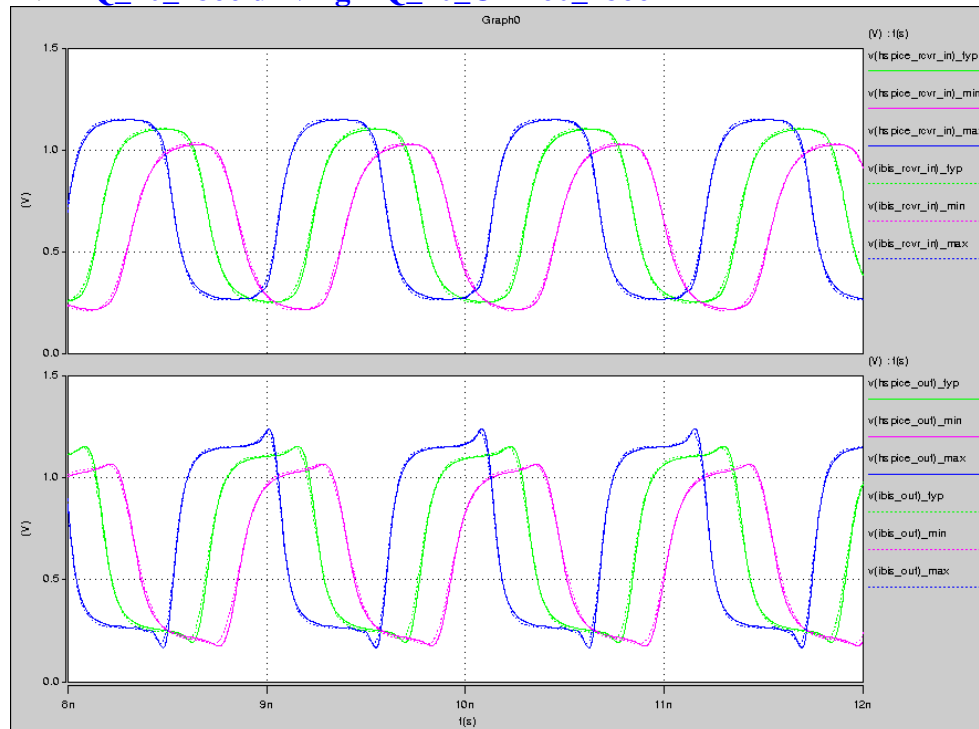
xx. **DQ\_34\_1866 driving DQ\_34\_ODT60\_1866**



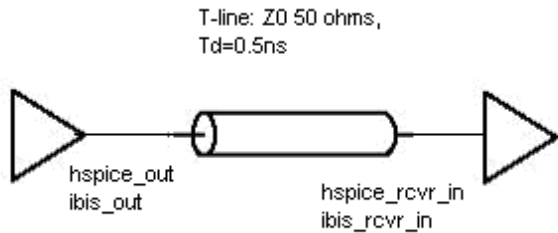
xxi. **DQ\_34\_1866 driving DQ\_34\_ODT120\_1866**



xxii. **DQ\_40\_1866 driving DQ\_40\_ODT60\_1866**



## Setup



## Comments:

1. IBIS model may not reflect speed grade availability.
2. IBIS Version is 4.2.
3. C\_comp is compared with the DDR3L-1600 specification only.
4. Slew rate is based on HSPICE simulation with a 25ohm load to Vtt. This includes simple package parasitics.
5. INPUT1\_\* is applicable to: A3, A4, A5, A6, A7, A8, A9, A13, A14, CKE, CS#, ODT  
INPUT2\_\* is applicable to: A0, A1, A2, A10, A11, A12, BA0, BA1, BA2, CAS#, RAS#, WE#

## Document Revision History

Rev **1.0** - Date **10/15/2012**

- a. IBIS revision **1.0**
- b. HSpice revision **1.0**

Rev **2.0** - Date **09/12/2014**

- a. IBIS revision **2.0**
- b. HSpice revision **2.0**