
IBIS/HSPICE Model Quality Report

Design ID: **V80A**

Description: **4Gb 1.35V DDR3L SDRAM**

Marketing device name(s): **MT41K1G4RH, MT41K512M8RH, MT41K256M16HA, MT41K1G4V80A, MT41K512M8V80A, MT41K256M16V80A**

Valid speed grades: **DDR3L-1066, DDR3L-1333, DDR3L-1600, DDR3L-1866¹**

Zip filename: **v80a_1p35_ibis.zip**

IBIS filename: **v80a_1p35.ibs, v80a_1p35_it.ibs** File rev: **2.4**

HSpice filename: **v80a_1p35_hspice.zip** File rev: **2.2**

EBD filename (if applicable): File rev:

Die rev: **E**

Date: **May 10, 2013**

Datasheet Link (from micron.com):

http://www.micron.com/~media/Documents/Products/Data%20Sheet/DRAM/4Gb_1_35V_DDR3L.pdf

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

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: **10.76nF**

Included in HSPICE DQ/DQS models? **Yes** Amount per DQ/DQS model: **538pF/1076pF**

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

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/.

Overall IBIS Quality Level: **IQ3MS**

Exceptions: **N/A**

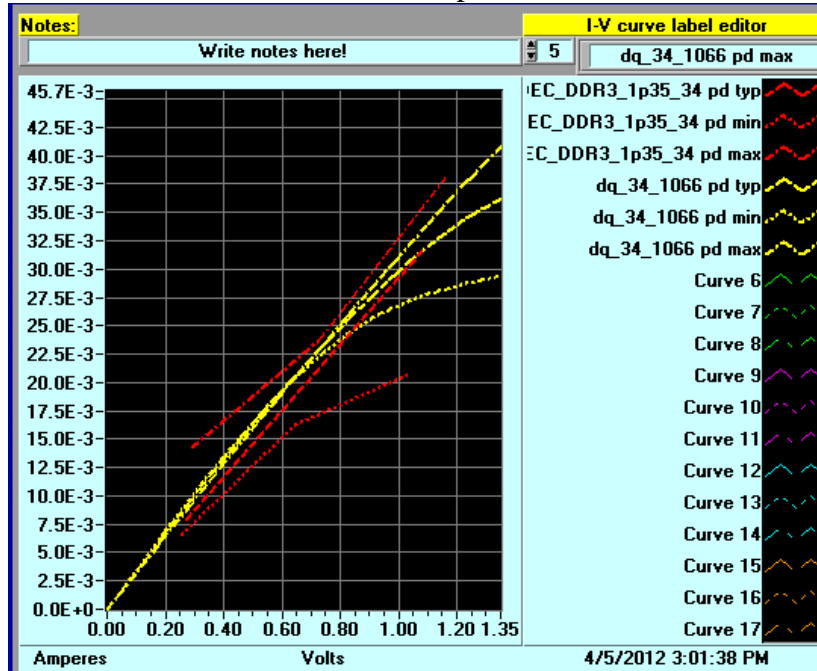
2. ☒ Include the filename of the IBIS Quality Checklist that accompanies this report.

Filename: **v80a_1p35_ibis_quality_checklist.xls**

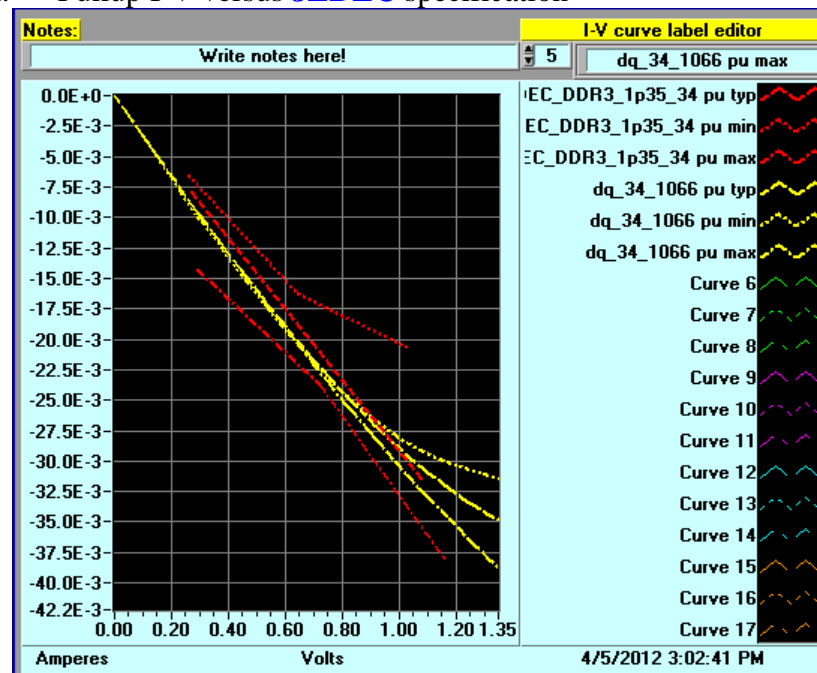
IBIS MODEL Correlation

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, DQ_34_1600, DQ_34_1866**^{2,3}
 - i. Pulldown I-V versus **JEDEC** specification

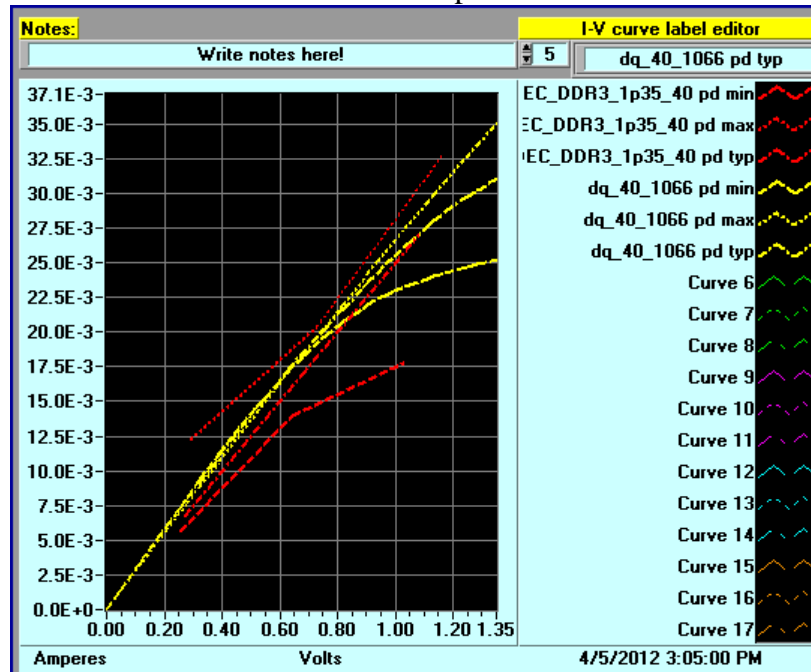


- ii. Pullup I-V versus **JEDEC** specification

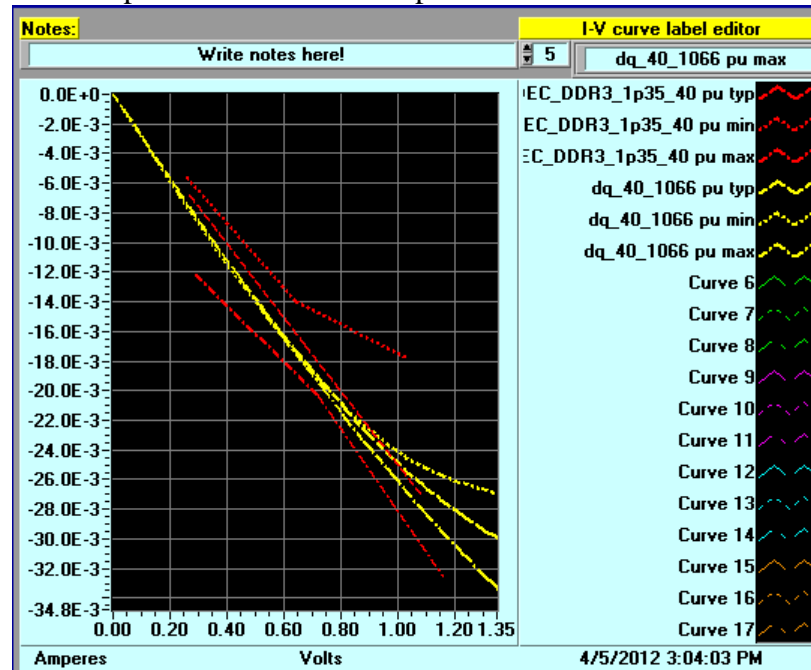


b. Model name: **DQ_40_1066, DQ_40_1600, DQ_40_1866**^{2,3}

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

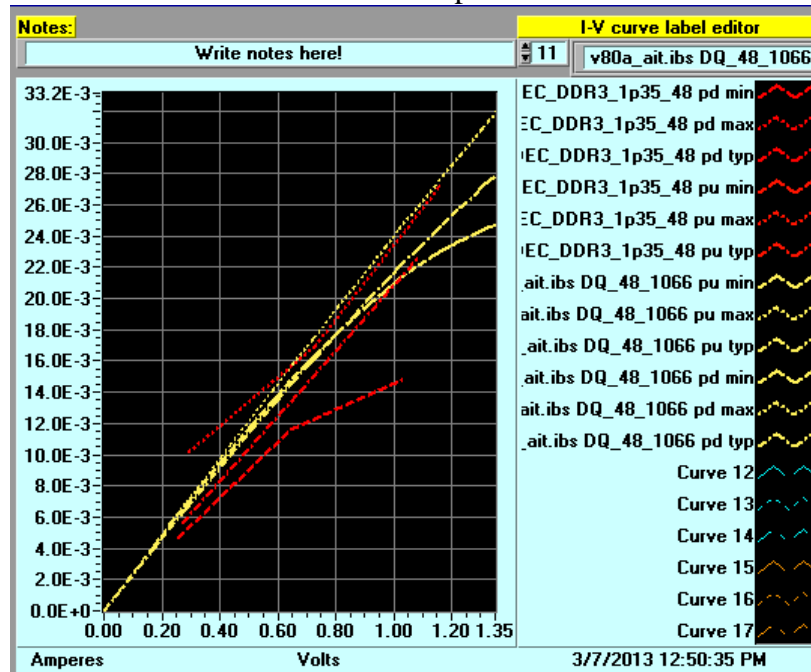


ii. Pullup I-V versus **JEDEC** specification

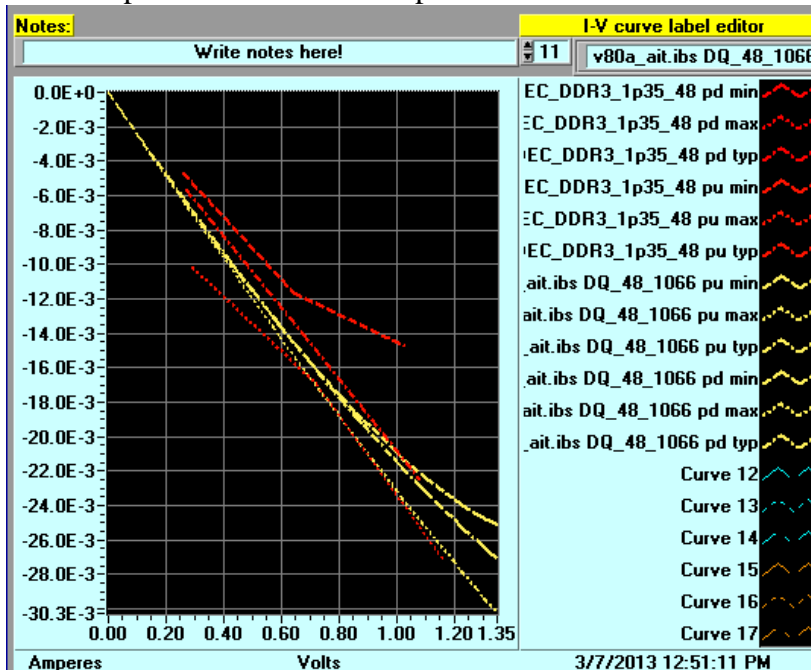


c. Model name: **DQ_48_1066, DQ_48_1600, DQ_40_1866**^{2,3,4}

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



ii. Pullup I-V versus **JEDEC** specification



1. ☒ 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).

Component name: **MT41K512M4RH, MT41K256M8RH (78b, x4/x8)**

		IBIS		Datasheet	
		Min	max	min	max
DQ	C_comp	1.28	1.43	NA	NA
	C package	0.34	0.50	NA	NA
	C_total	1.62	1.93	1.50	2.30
INPUT	C_comp	0.58	0.73	NA	NA
	C package	0.27	0.44	NA	NA
	C_total	0.84	1.17	0.75	1.30
CLK	C_comp	0.53	0.68	NA	NA
	C package	0.36	0.37	NA	NA
	C_total	0.88	1.05	0.80	1.40

Component name: **MT41K128M16HA (96b, x16)**

		IBIS		Datasheet	
		min	max	min	max
DQ	C_comp	1.28	1.43	NA	NA
	C package	0.26	0.44	NA	NA
	C_total	1.53	1.87	1.50	2.30
INPUT	C_comp	0.58	0.73	NA	NA
	C package	0.21	0.37	NA	NA
	C_total	0.79	1.10	0.75	1.30
CLK	C_comp	0.53	0.68	NA	NA
	C package	0.26	0.26	NA	NA
	C_total	0.78	0.94	0.80	1.40

2. ☒ If slew rate specifications (rise/fall slew) are available from the datasheet, complete Spice simulations to generate slew rate data and provide a comparison table.

Model	Slew Rate (V/ns)	IBIS			Datasheet	
		min	typ	max	min	max
DQ_34_1066	Rising	2.37	3.32	4.58	2.50	6.00
	Falling	2.05	2.97	4.15	2.50	6.00
DQ_40_1066	Rising	2.27	3.38	4.59	2.50	6.00
	Falling	1.90	3.15	4.35	2.50	6.00
DQ_34_1600	Rising	2.61	3.45	4.65	2.50	6.00
	Falling	2.15	3.01	4.20	2.50	6.00
DQ_40_1600	Rising	2.40	3.45	4.61	2.50	6.00
	Falling	2.02	3.15	4.34	2.50	6.00
DQ_34_1866	Rising	2.84	3.61	4.73	2.50	6.00
	Falling	2.35	3.11	4.19	2.50	6.00
DQ_40_1866	Rising	2.55	3.53	4.69	2.50	6.00
	Falling	2.06	3.20	4.37	2.50	6.00

3. ☒ 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)	-7.88E-03	-7.06E-03	-8.62E-03
Ivih (A)	7.57E-03	6.84E-03	8.16E-03
	TYP	MAX	MIN
Rtt (Model)	20.72	23.01	19.07
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)	-4.82E-03	-4.32E-03	-5.28E-03
Ivih (A)	4.59E-03	4.17E-03	4.95E-03
	TYP	MAX	MIN
Rtt (Model)	33.98	37.72	31.29
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)	-3.53E-03	-3.17E-03	-3.86E-03
Ivih (A)	3.51E-03	3.18E-03	3.79E-03
	TYP	MAX	MIN
Rtt (Model)	45.43	50.35	41.85
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)	-2.40E-03	-2.15E-03	-2.63E-03
Ivih (A)	2.31E-03	2.09E-03	2.49E-03
	TYP	MAX	MIN
Rtt (Model)	67.92	75.40	62.53
Rtt (datasheet-in units of ZQ/12)	1.0	1.6	0.9
Rtt (datasheet)	60	96	54

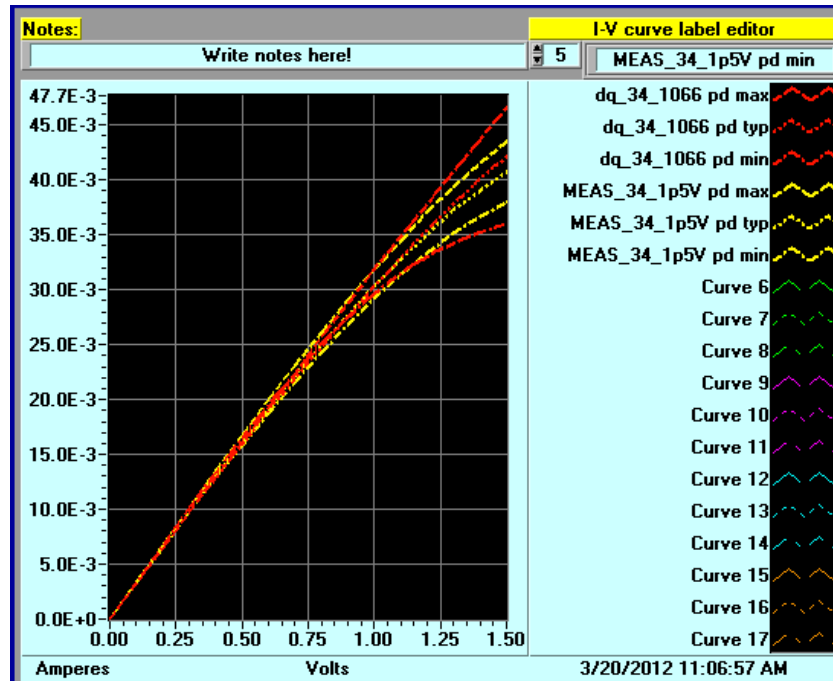
ODT120	TYP	MIN	MAX
Vil (V)	0.515	0.4815	0.5525
Vih (V)	0.835	0.8015	0.8725
Ivil (A)	-1.13E-03	-1.02E-03	-1.22E-03
Ivih (A)	1.21E-03	1.09E-03	1.31E-03
	TYP	MAX	MIN
Rtt (Model)	137.13	151.56	126.55
Rtt (datasheet-in units of ZQ/12)	1.0	1.6	0.9
Rtt (datasheet)	120	192	108

Measurement Correlation

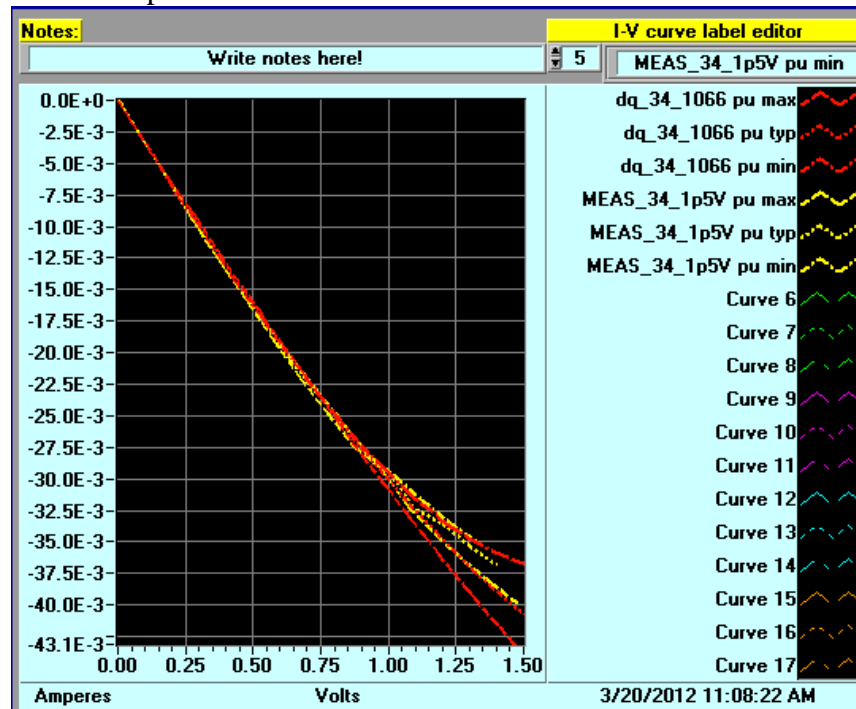
1. ☒ For Output or I/O models compare measured IOH/IOL data with IBIS pullup/pulldown data. If the measurement conditions are different than the IBIS conditions, run Spice simulations using the same measurement conditions such as VCC, temperature, and process. Include measurement conditions in the image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

a. Model name: **DQ_34_1066, DQ_34_1600, DQ_34_1866**^{2,3}

i. Pulldown I-V versus Measurement

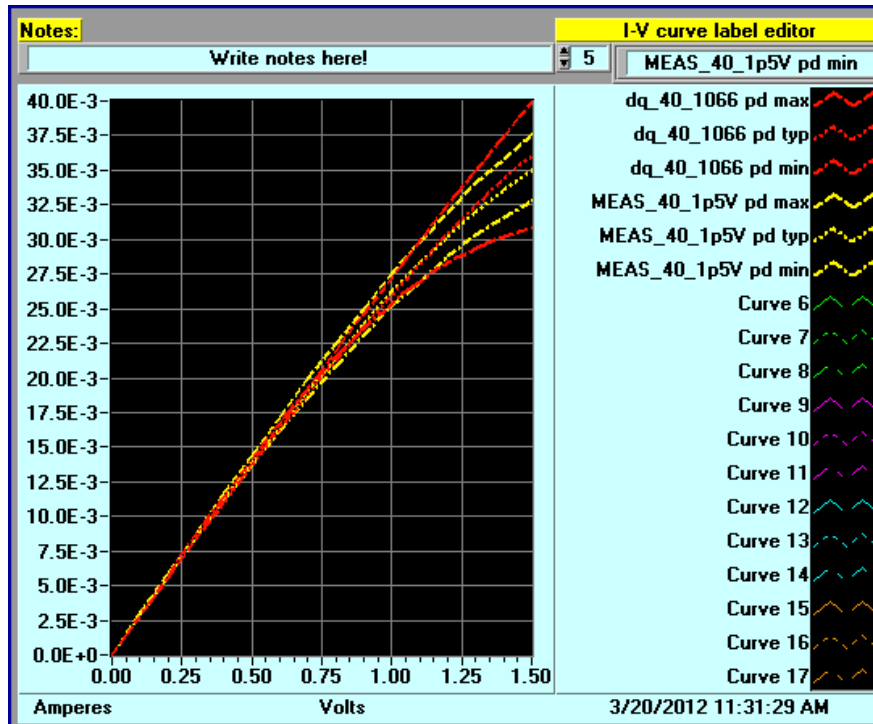


ii. Pullup I-V versus Measurement

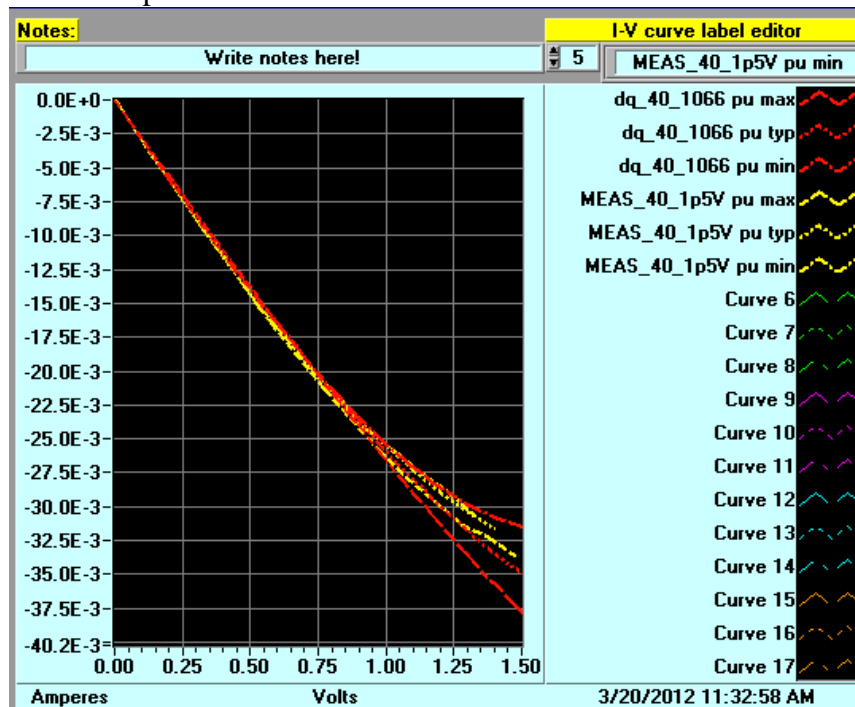


b. Model name: **DQ_40_1066, DQ_40_1600, DQ_40_1866**^{2,3}

i. Pulldown I-V versus Measurement



ii. Pullup I-V 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).

Component name: **MT41K512M4RH, MT41K256M8RH (78b, x4/x8)**

		IBIS			Measured		
		min	Typ	max	min	typ	max
DQ	C_comp	1.28	1.35	1.43	NA	NA	NA
	C package	0.34	0.42	0.50	NA	NA	NA
	C_total	1.62	1.77	1.93	1.65	1.74	1.85
INPUT	C_comp	0.58	0.65	0.73	NA	NA	NA
	C package	0.27	0.33	0.44	NA	NA	NA
	C_total	0.84	0.98	1.17	0.86	0.93	1.09
CLK	C_comp	0.53	0.60	0.68	NA	NA	NA
	C package	0.36	0.36	0.37	NA	NA	NA
	C_total	0.88	0.96	1.05	0.90	0.93	0.95

Component name: **MT41K128M16HA (96b, x16)**

		IBIS			Measured		
		min	Typ	max	min	typ	max
DQ	C_comp	1.28	1.35	1.43	NA	NA	NA
	C package	0.26	0.32	0.44	NA	NA	NA
	C_total	1.53	1.67	1.87	1.61	1.71	1.84
INPUT	C_comp	0.58	0.65	0.73	NA	NA	NA
	C package	0.21	0.30	0.37	NA	NA	NA
	C_total	0.79	0.95	1.10	0.85	0.97	1.06
CLK	C_comp	0.53	0.60	0.68	NA	NA	NA
	C package	0.26	0.26	0.26	NA	NA	NA
	C_total	0.78	0.86	0.94	0.85	0.86	0.87

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

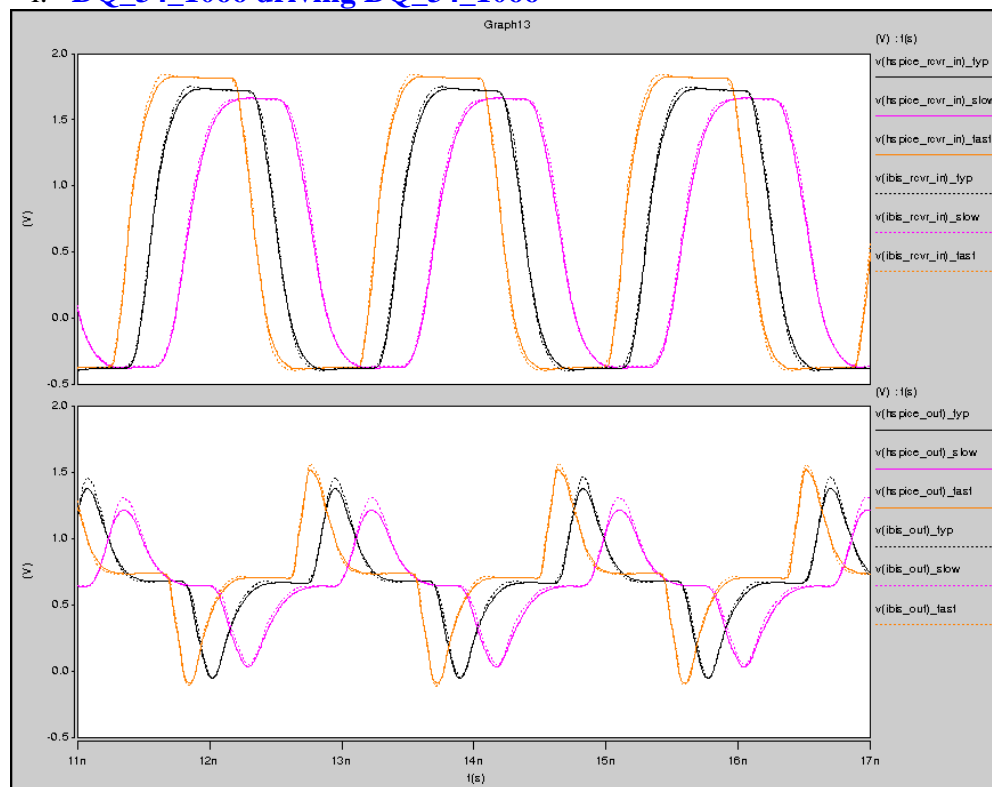
4. ☐ If slew rate data (rise/fall slew) is available from measurements, complete Spice simulations to generate slew rate data and provide a comparison table.

Not Available

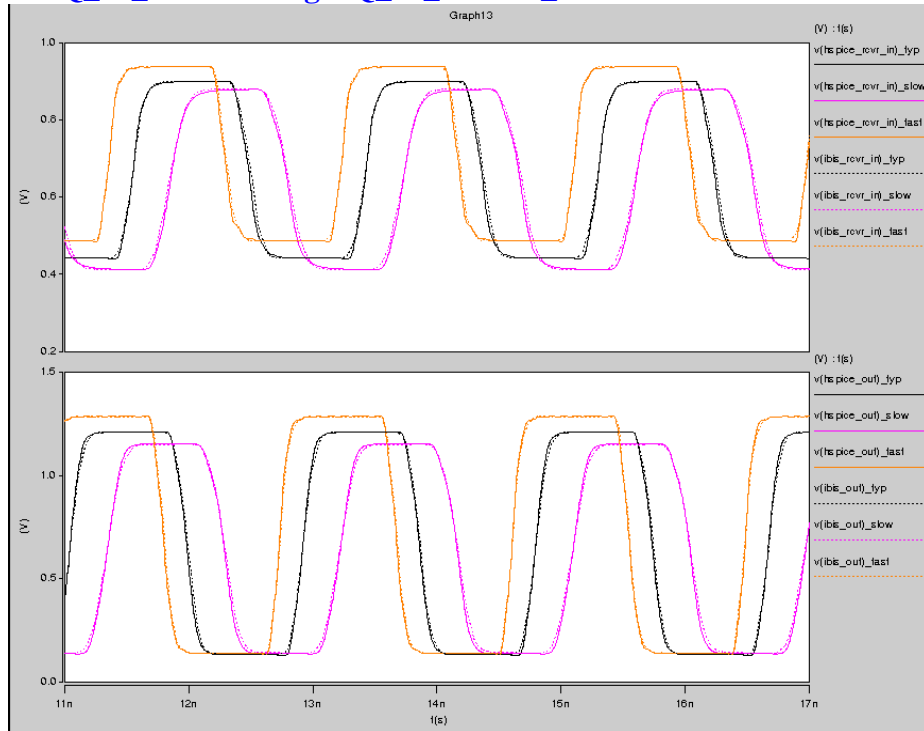
IBIS vs Spice Correlation

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: **HSPICE 2008.09**
 - b. ☒ Run simulations for all corners cases and at fastest speed grades, testing ODT models as loads when applicable.

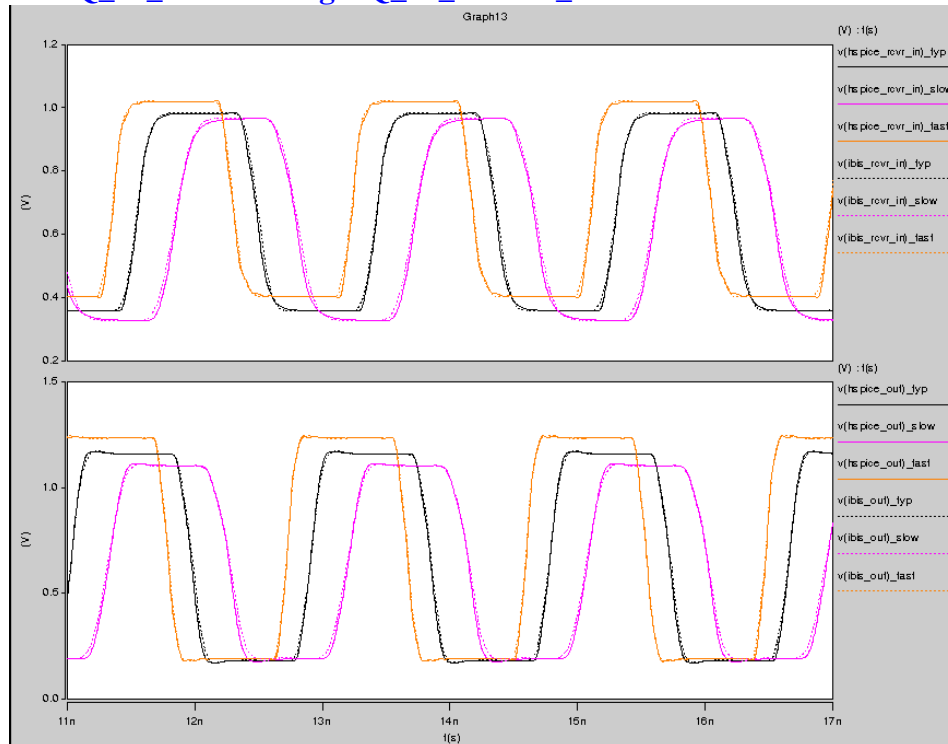
i. **DQ_34_1066 driving DQ_34_1066**



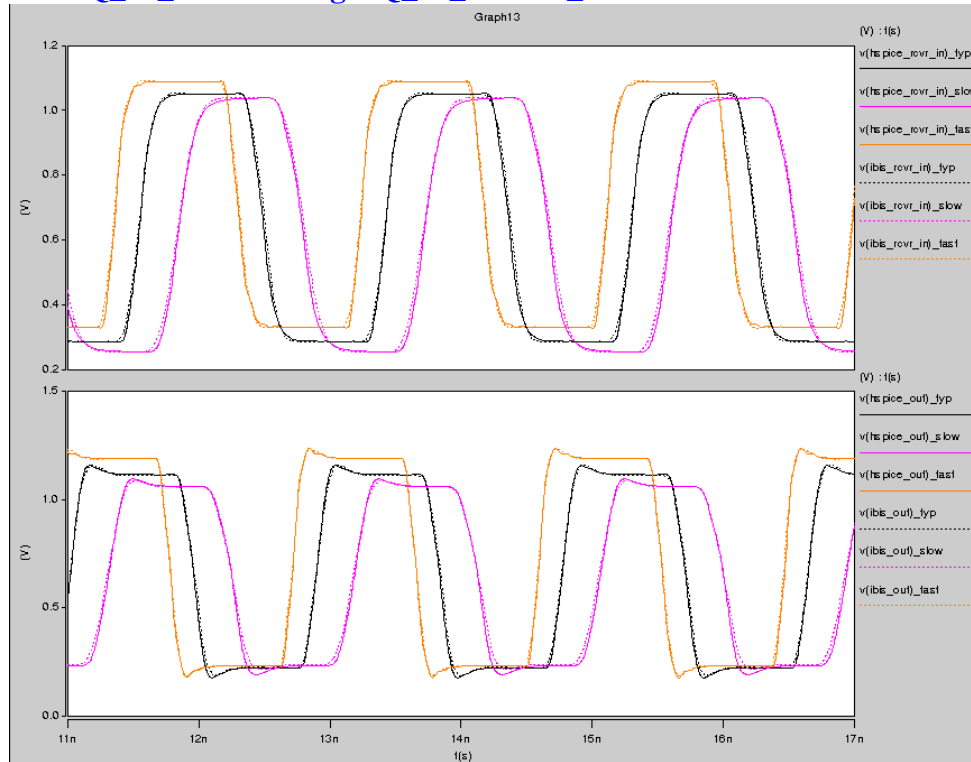
ii. **DQ_34_1066 driving DQ_34_ODT20_1066**



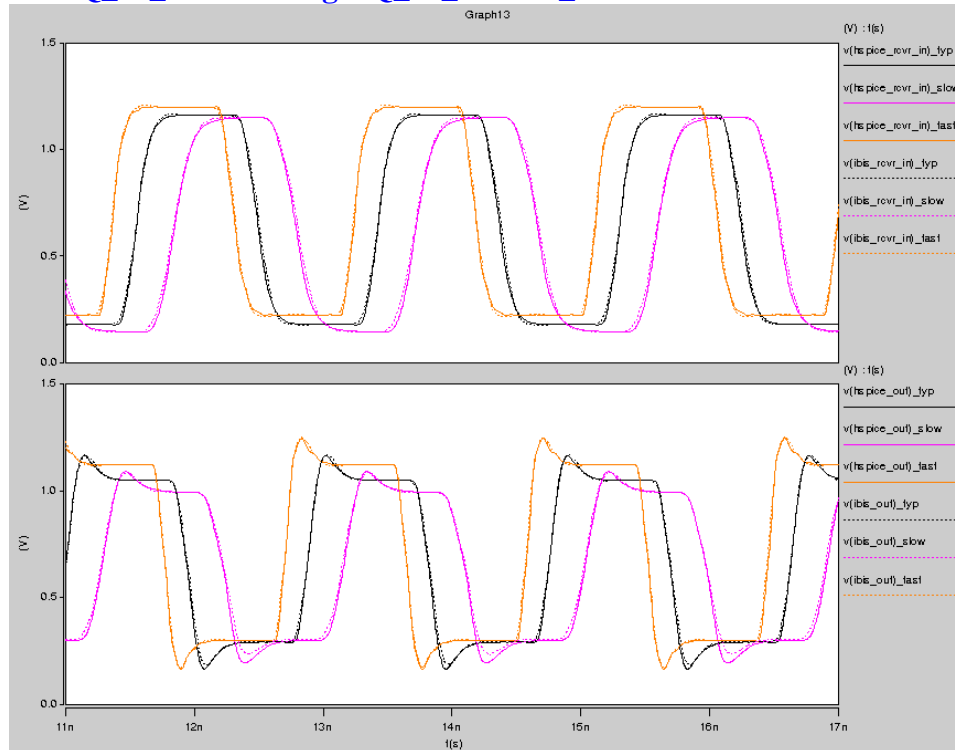
iii. **DQ_34_1066 driving DQ_34_ODT30_1066**



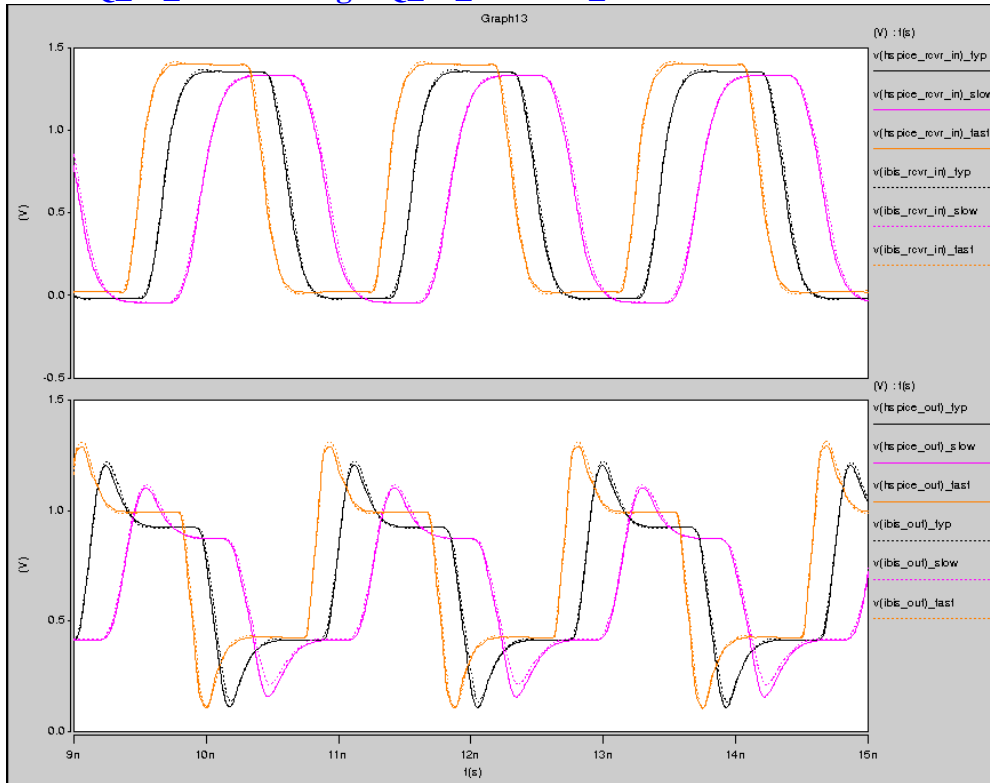
iv. **DQ_34_1066 driving DQ_34_ODT40_1066**



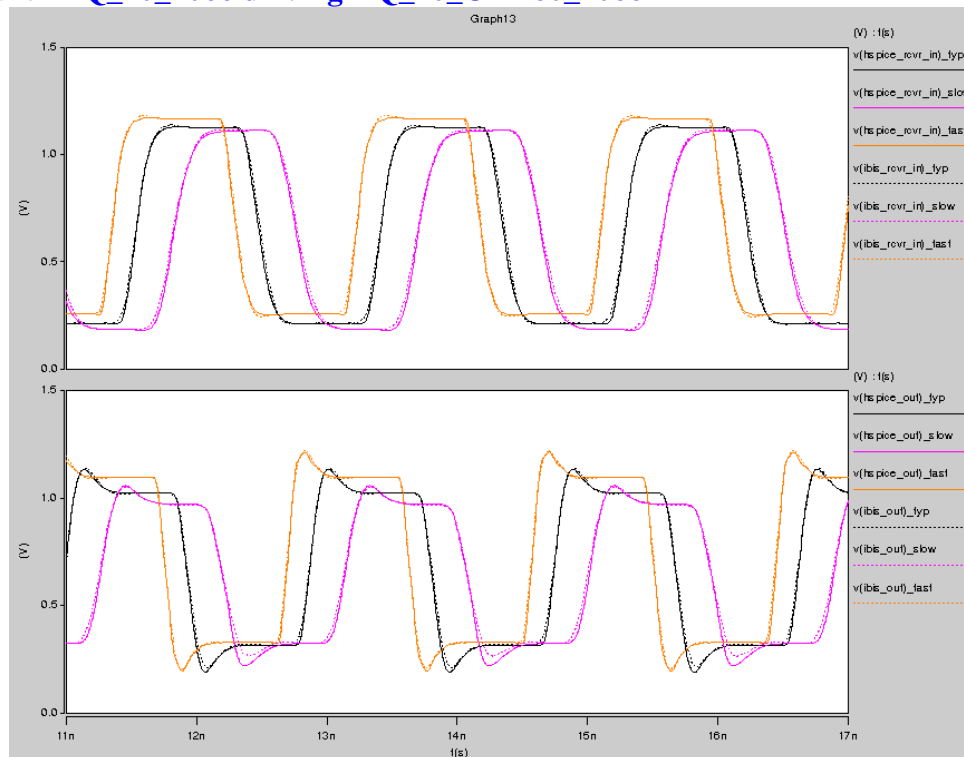
v. **DQ_34_1066 driving DQ_34_ODT60_1066**



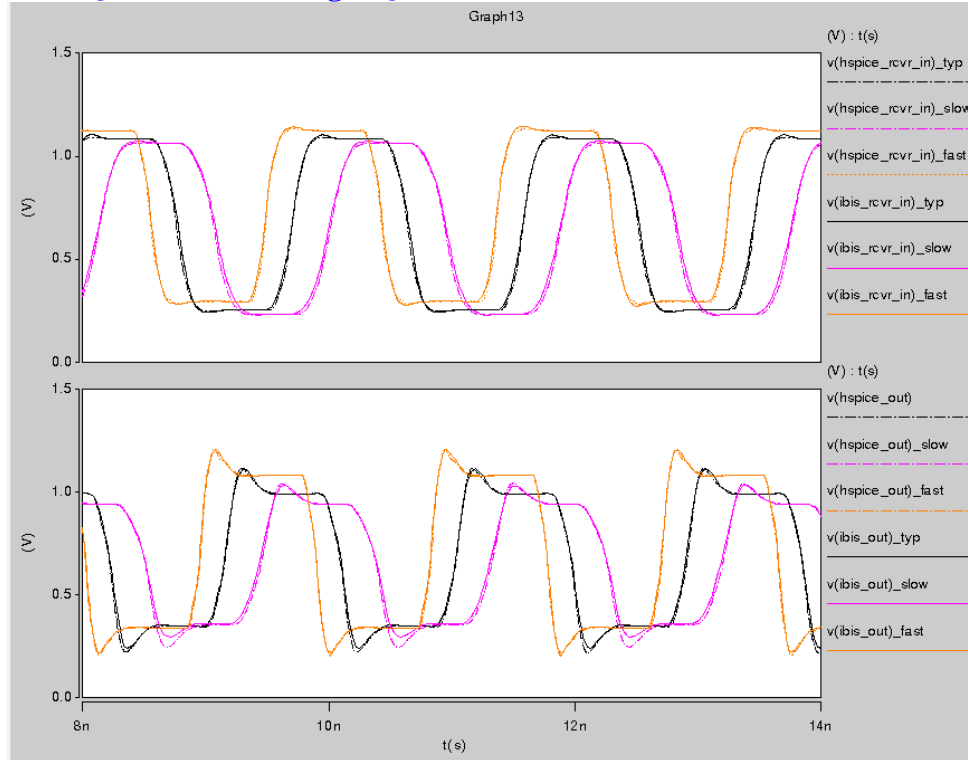
vi. **DQ_34_1066 driving DQ_34_ODT120_1066**



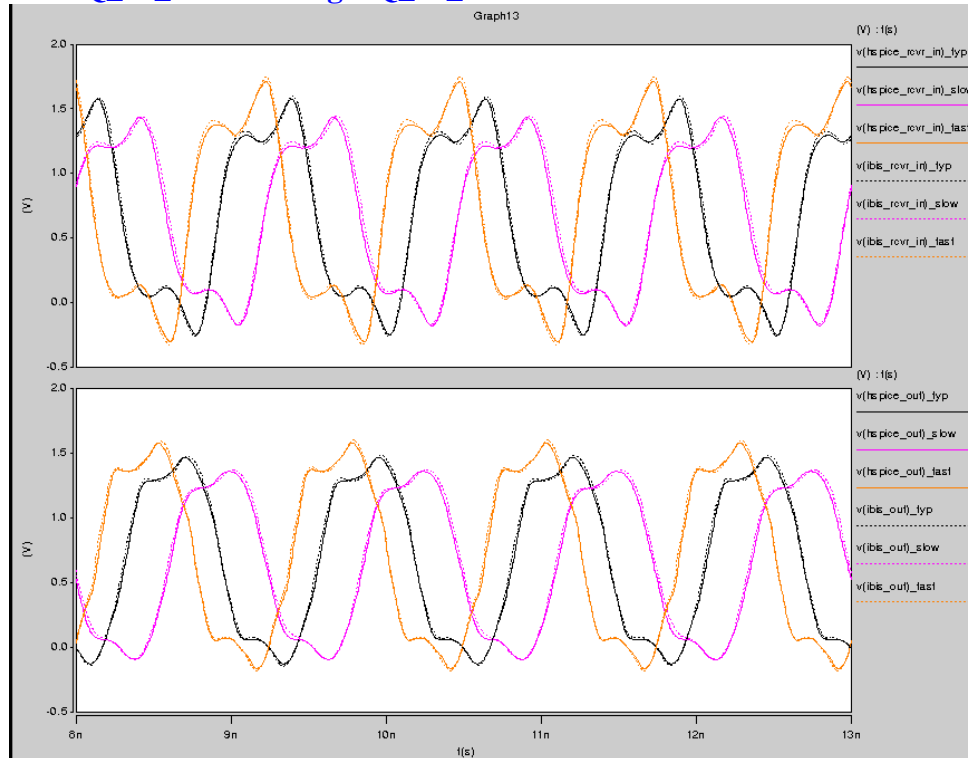
vii. **DQ_40_1066 driving DQ_40_ODT60_1066**



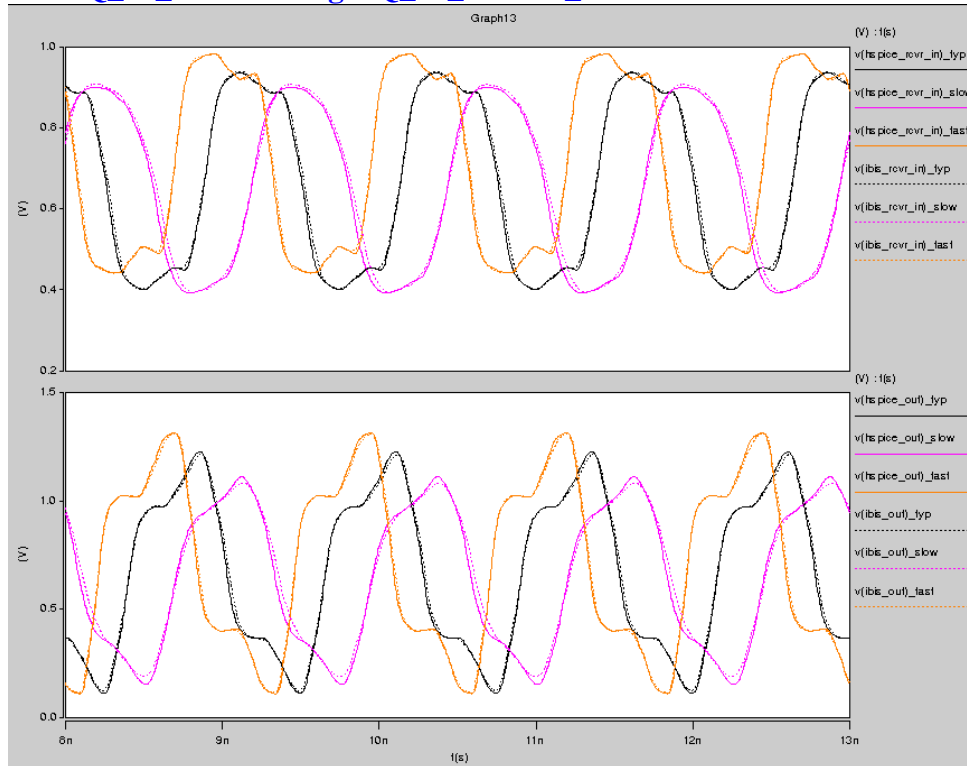
viii. **DQ_48_1066 driving DQ_48_ODT60_1066**



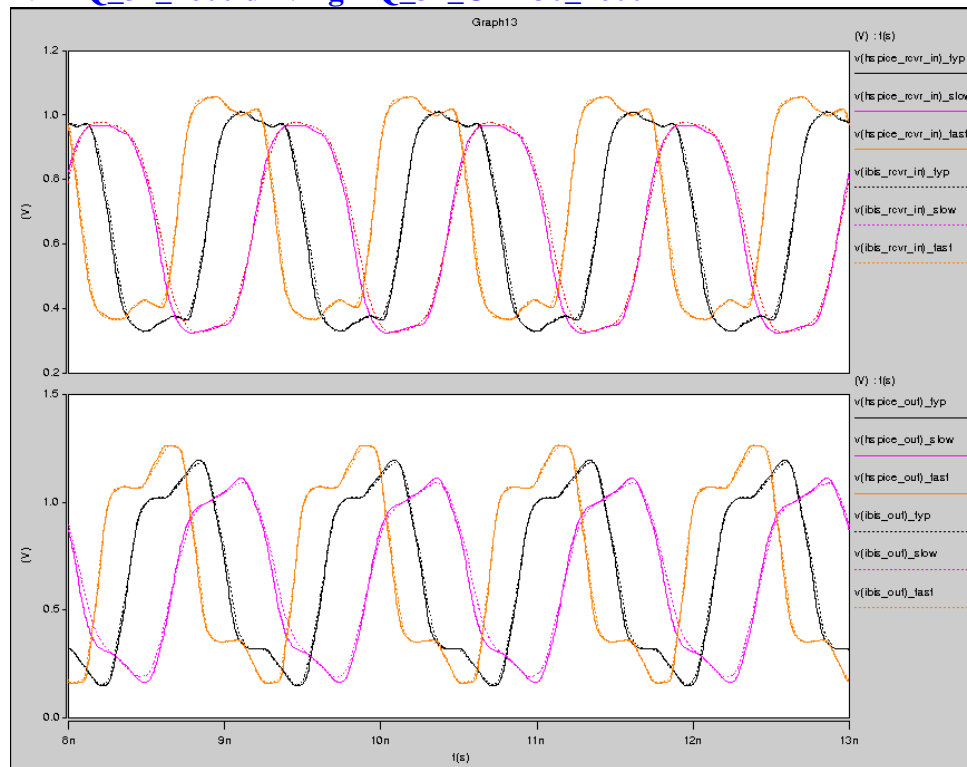
ix. **DQ_34_1600 driving DQ_34_1600**



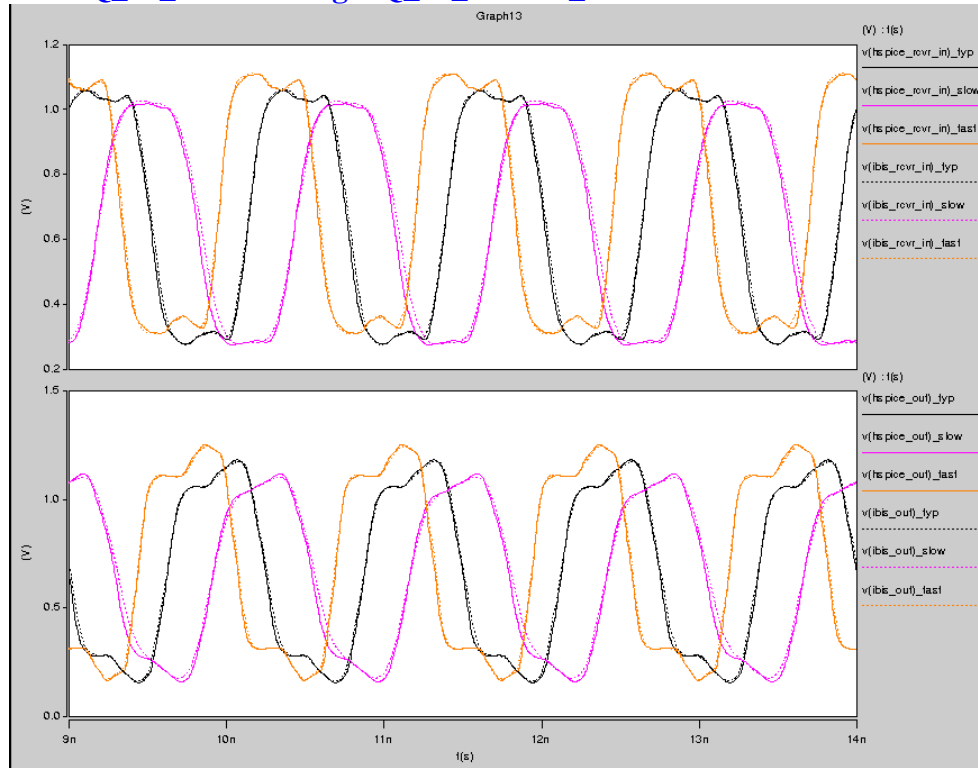
x. **DQ_34_1600 driving DQ_34_ODT20_1600**



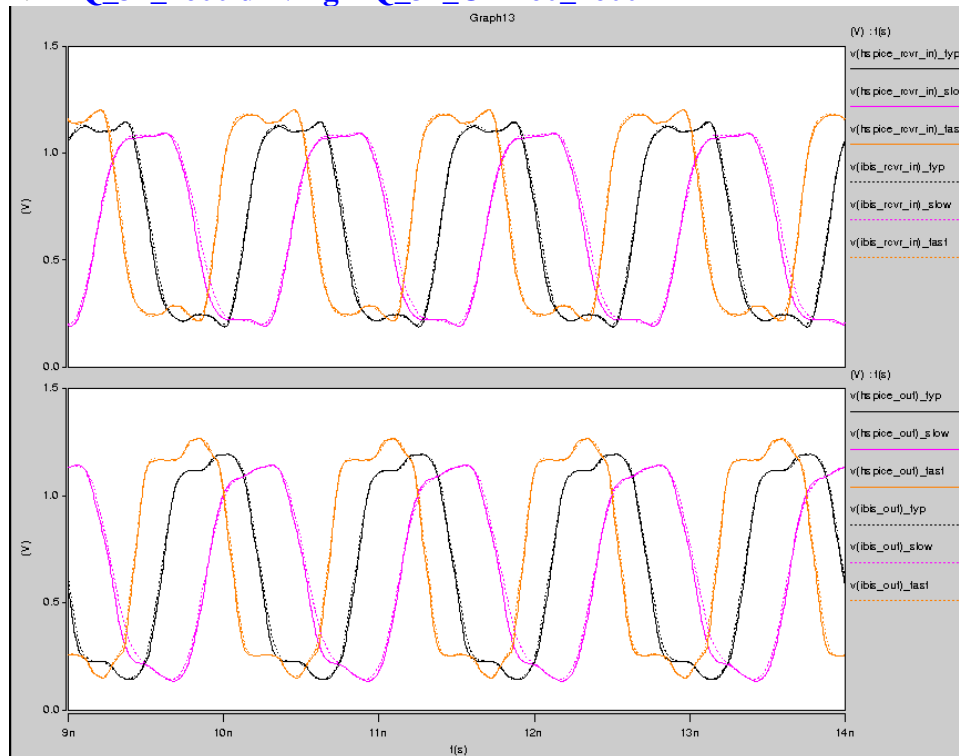
xi. **DQ_34_1600 driving DQ_34_ODT30_1600**



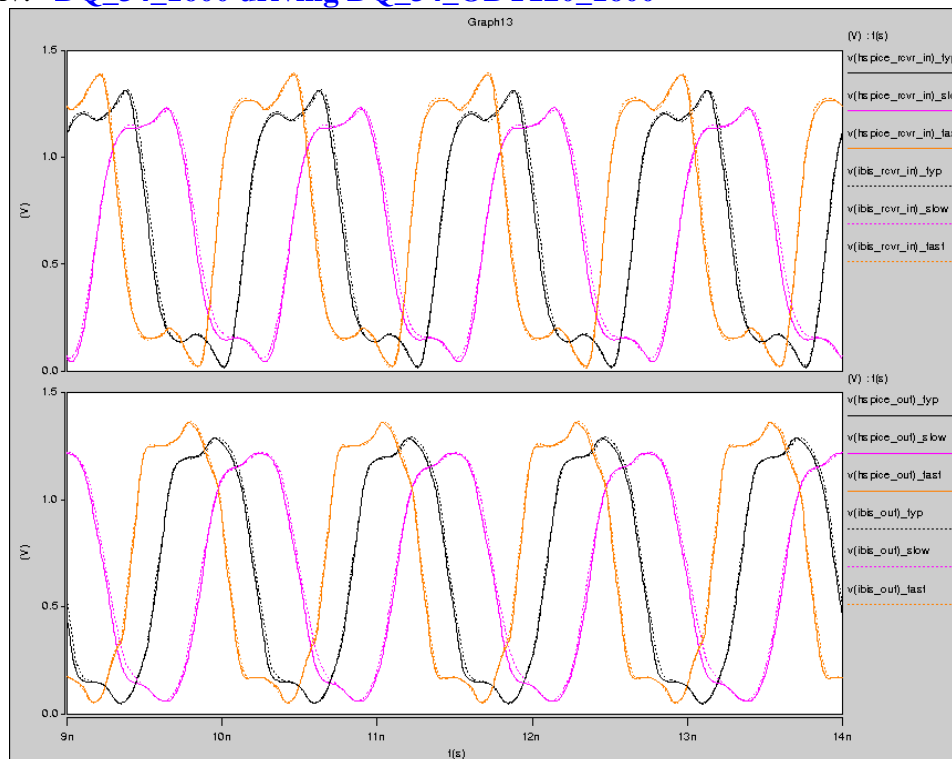
xii. **DQ_34_1600 driving DQ_34_ODT40_1600**



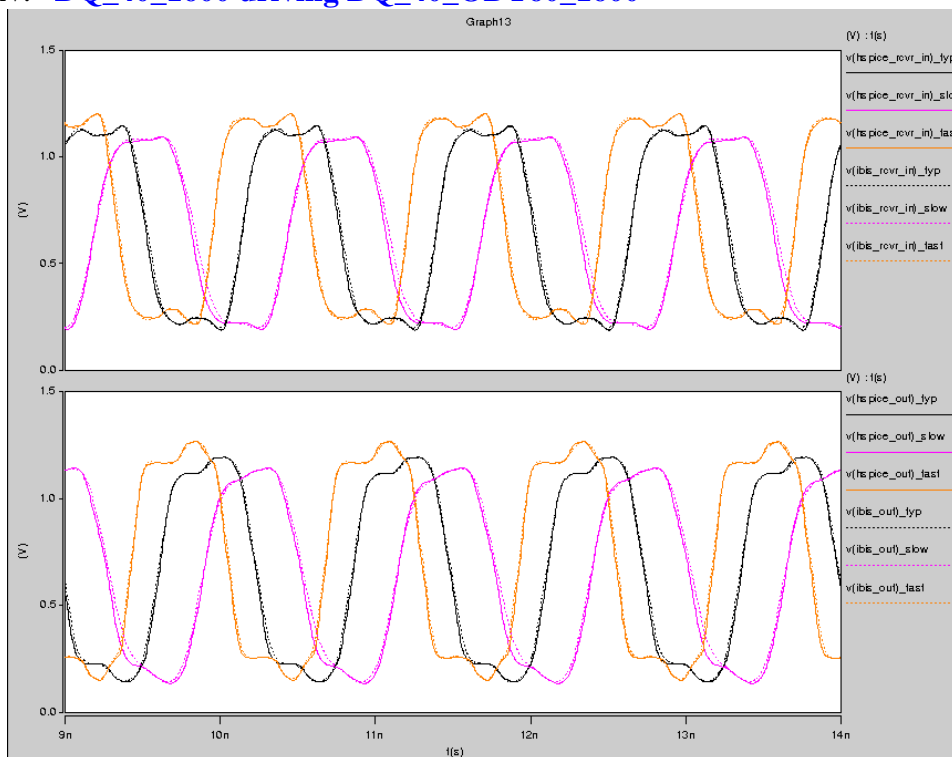
xiii. **DQ_34_1600 driving DQ_34_ODT60_1600**



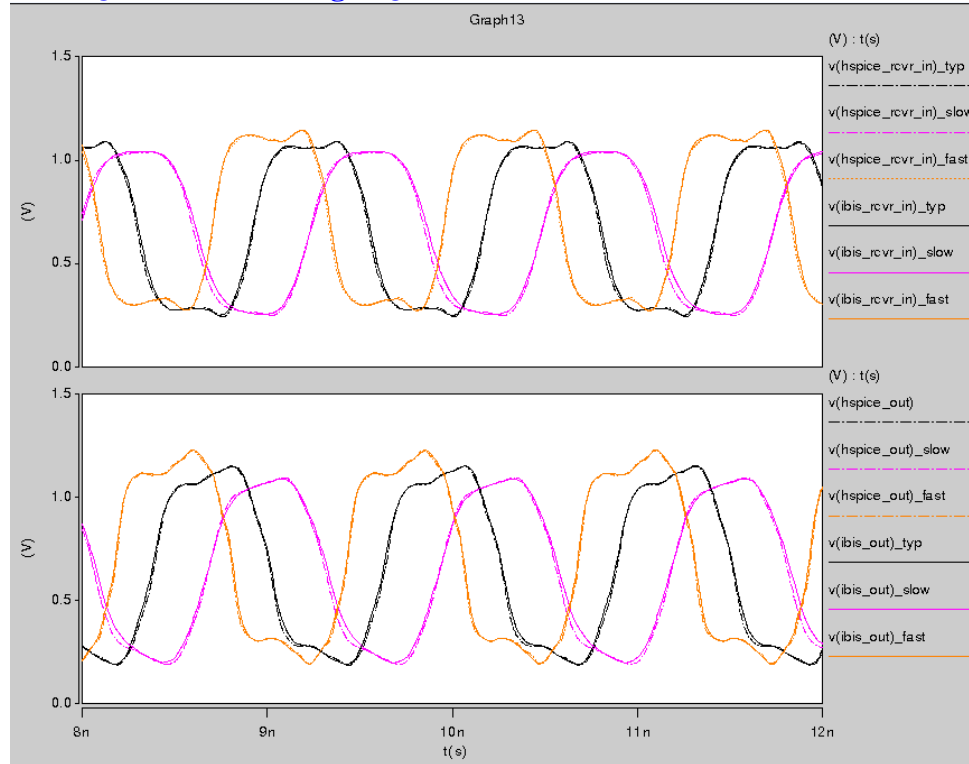
xiv. **DQ_34_1600 driving DQ_34_ODT120_1600**



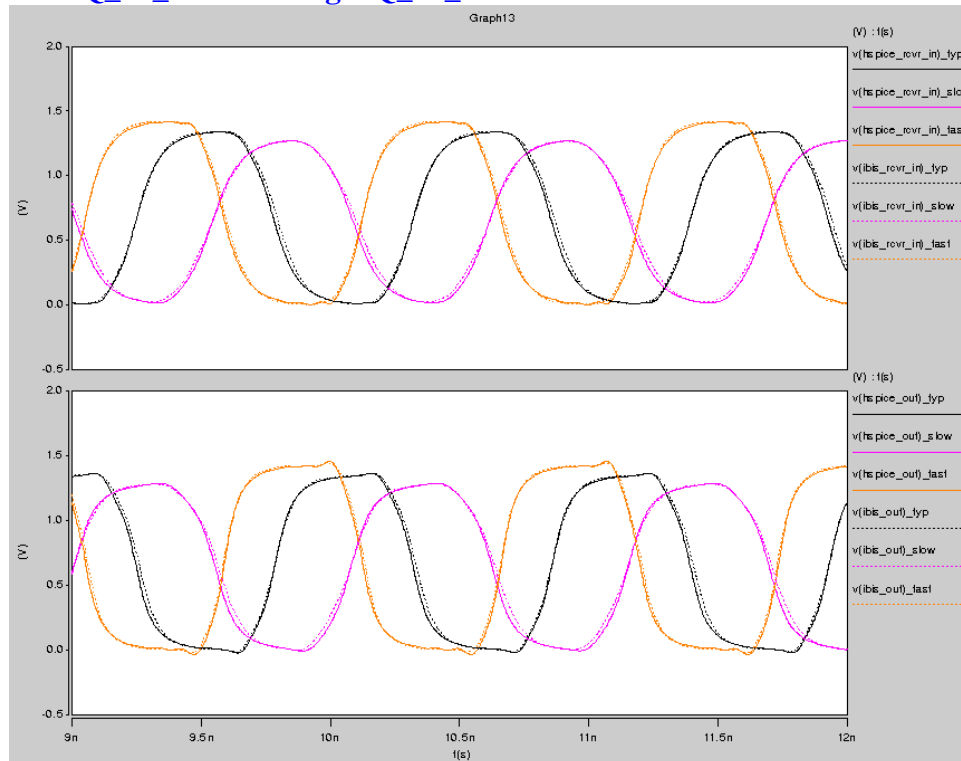
xv. **DQ_40_1600 driving DQ_40_ODT60_1600**



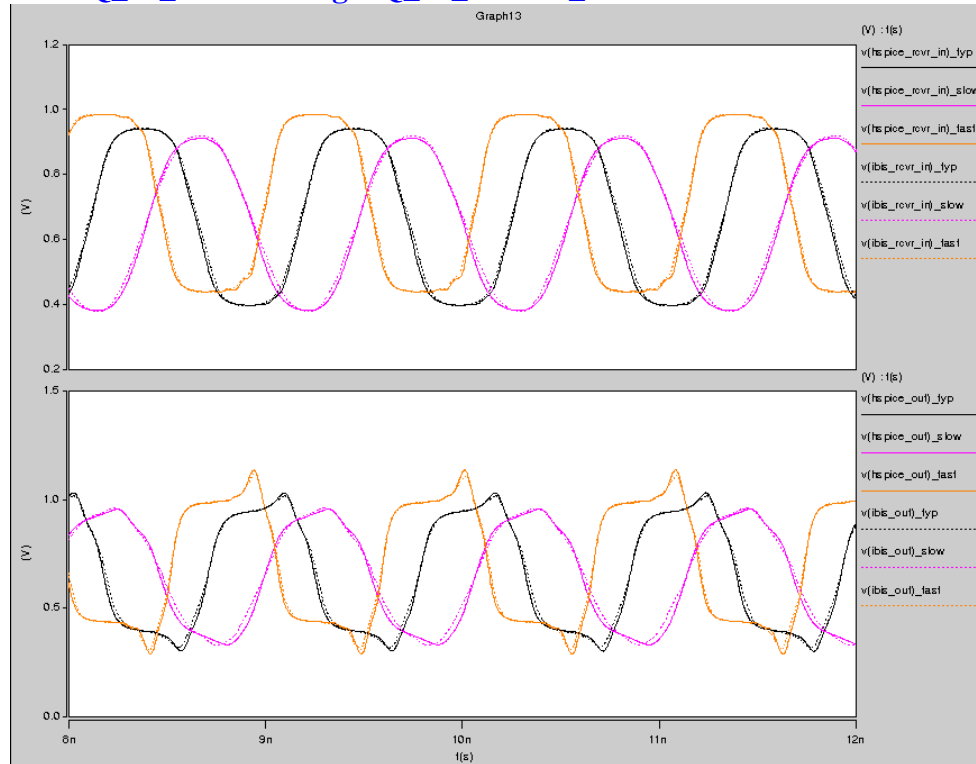
xvi. **DQ_48_1600 driving DQ_48_ODT60_1600**



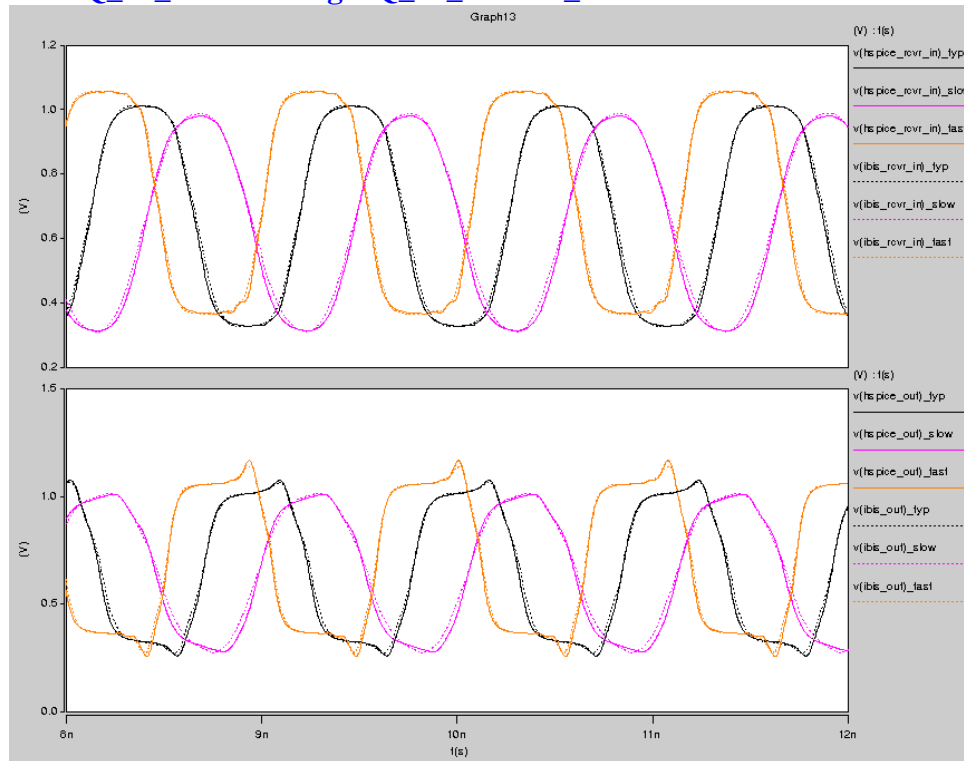
xvii. **DQ_34_1866 driving DQ_34_1866**



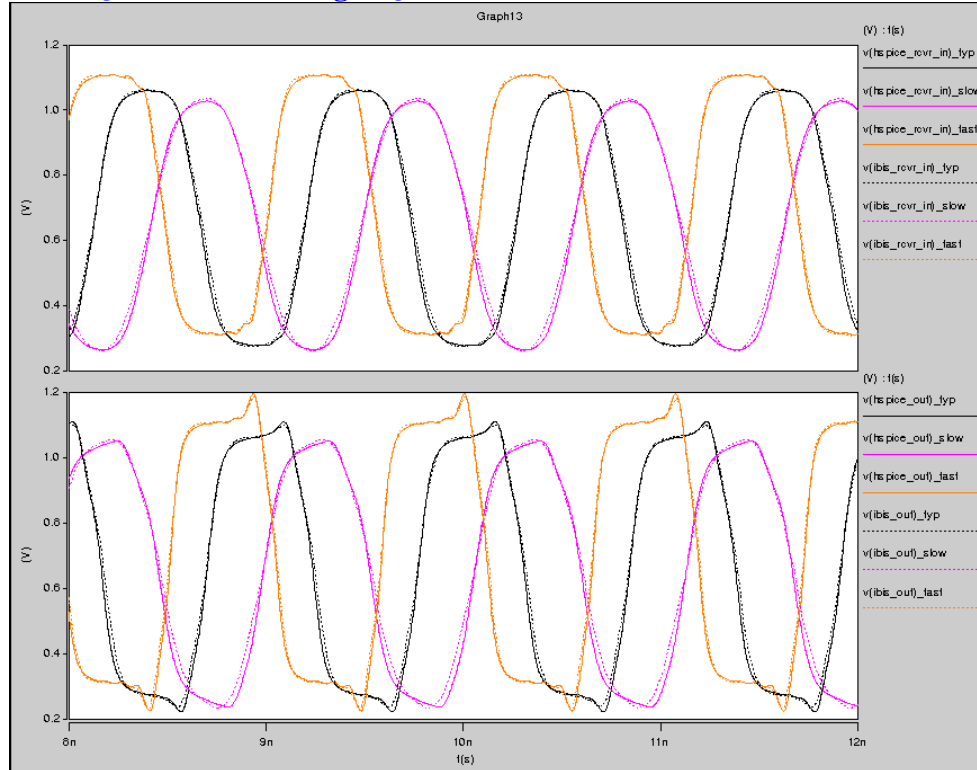
xviii. **DQ_34_1866 driving DQ_34_ODT20_1866**



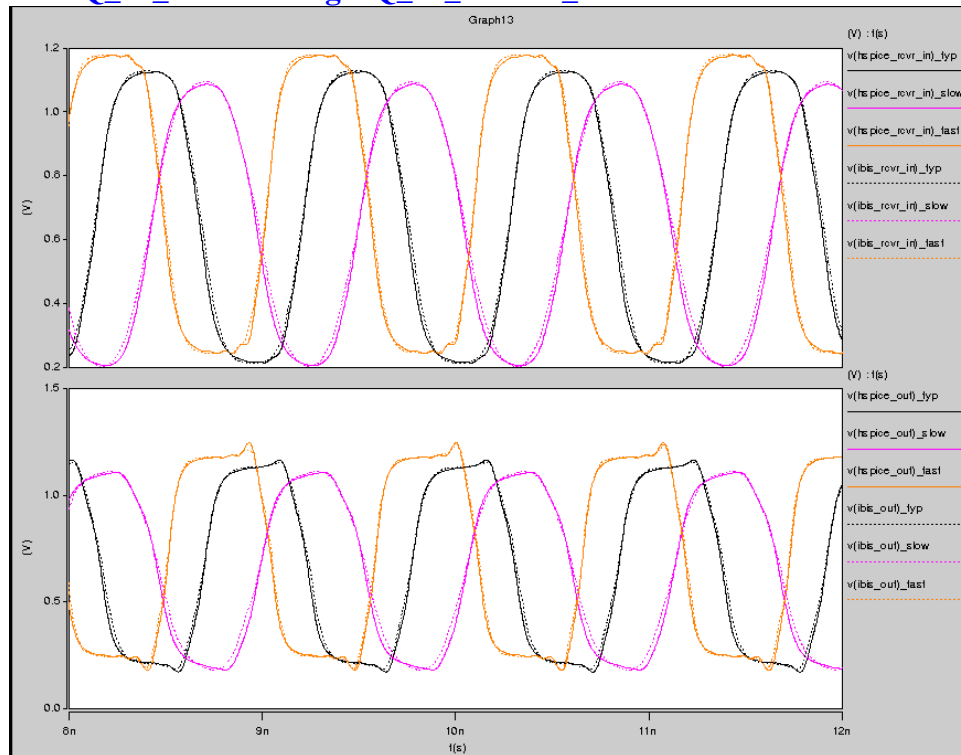
xix. **DQ_34_1866 driving DQ_34_ODT30_1866**



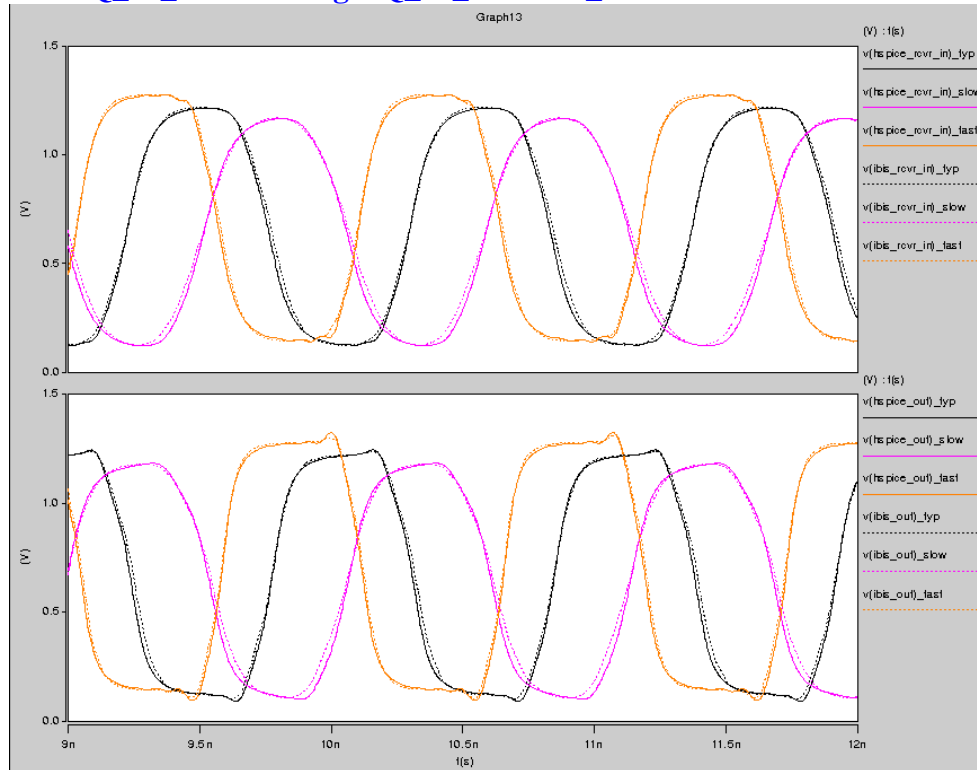
xx. **DQ_34_1866 driving DQ_34_ODT40_1866**



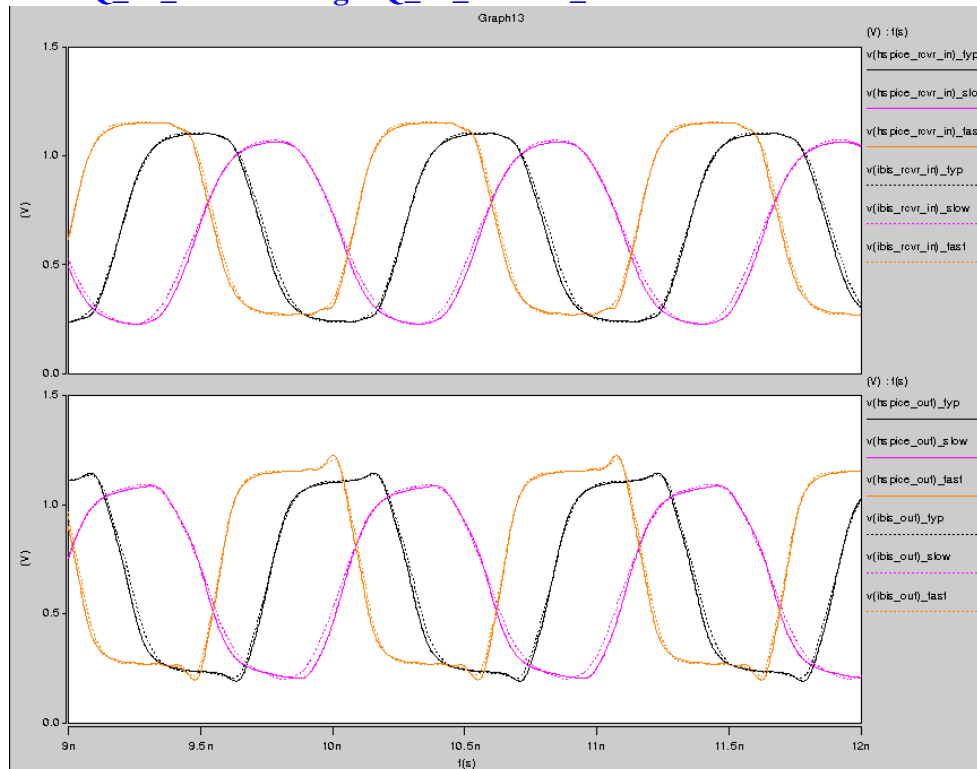
xxi. **DQ_34_1866 driving DQ_34_ODT60_1866**



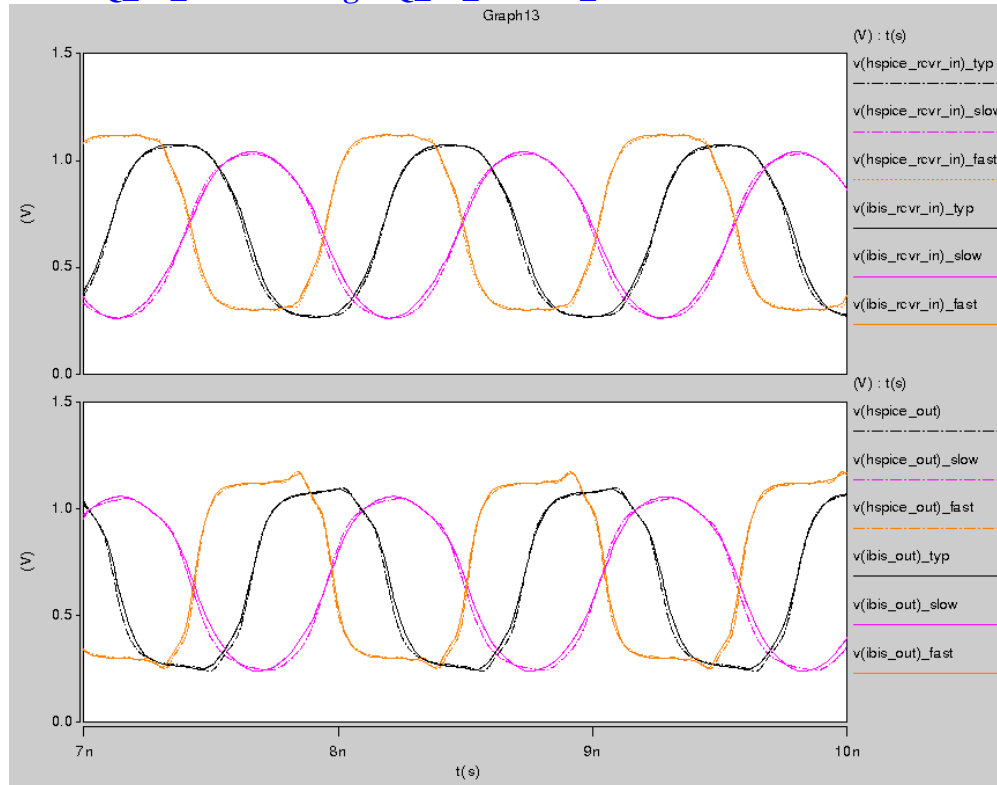
xxii. **DQ_34_1866 driving DQ_34_ODT120_1866**



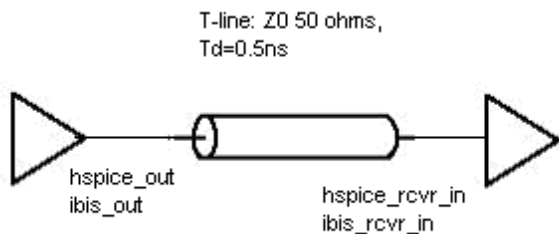
xxiii. **DQ_40_1866 driving DQ_40_ODT60_1866**



xxiv. **DQ_48_1866 driving DQ_48_ODT60_1866**



Setup



Comments:

1. IBIS model may not reflect speed grade availability.
2. Simulated I_V curves are the same for all speed grades.
3. IBIS Version is 4.2.
4. Only AIT model uses the 48 Ohm settings therefore it is not customary to match Pulldown and Pullup I-V measurements to these settings. 34 Ohm and 40 Ohm settings were matched to Pulldown and Pullup I-V measurements.
5. C_comp is compared with the DDR3L-1600 specification only.
6. Slew rate is based on HSPICE simulation with a 25ohm load to Vtt. This includes simple package parasitics.

Document Revision History

- Rev **1.0** - Date **08/17/2011**
- a. IBIS revision **1.0**
 - b. HSpice revision **1.0**
- Rev **2.0** - Date **04/11/2012**
- a. IBIS revision **2.0**
 - b. HSpice revision **2.0**
- Rev **2.1** - Date **06/19/2012**
- a. IBIS revision **2.1**
 - b. HSpice revision **2.0**
- Rev **2.2** - Date **07/11/2012**
- a. IBIS revision **2.2**
 - b. HSpice revision **2.0**
- Rev **2.3** - Date **03/05/2013**
- a. IBIS revision **2.3**
 - b. HSpice revision **2.1**
- Rev **2.4** - Date **05/10/2013**
- a. IBIS revision **2.4**
 - b. HSpice revision **2.2**