



Hi3516CV500 DDR4 Signal Integrity Report



System History

Date	Contents	Remarks
2019-3-16	The test is performed based on the DDR4 1866MHz standard	
Note: All the test data in this report is the test result of the HiSilicon test sample and is only for reference. Note that the tests conducted by HiSilicon cannot replace customers' related tests.		

Chipset	Hi3516CV500
Board Name	HI3516CV500DDR4DMEB VER.A
DRAM Part Number	MT41K256M16TW-107:P
Oscilloscope	DSA72004C TEKTRONIX
Temperature	25°C
DRAM Operating Frequency	900MHz(DDR3L)
Vdd/Vref_CA/Vref_DQ/Vcore	1.2V/0.6V/Training/0.9V
DRAM_ODT	120ohm
SOC_ODT	120ohm
DRAM_RON	40ohm
SOC_RON	CK=34ohm 1T(CS/CKE/ODT)=34ohm 2T=34ohm DQ=40ohm DQS=40ohm

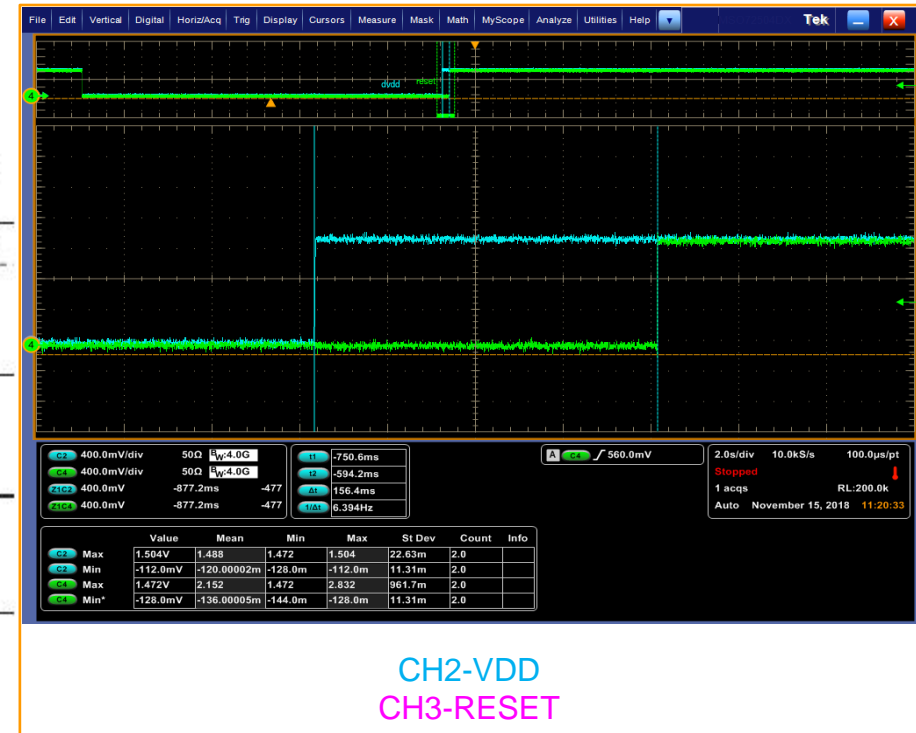
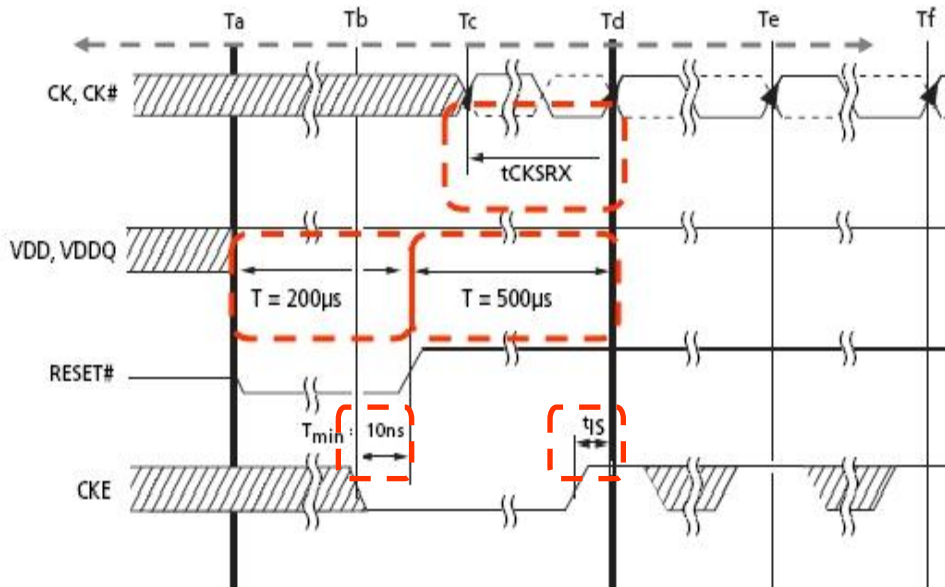


Signal Integrity Summary& Conclusion

Judgment&Summary		
Measurement Item	Result	Remark
Sequence Check	PASS	
Power Check	PASS	
Signal Integrity Check	PASS	

▣ Stable VDD to /Reset Up

3.3.1 Power-up Initialization Sequence (Cont'd)

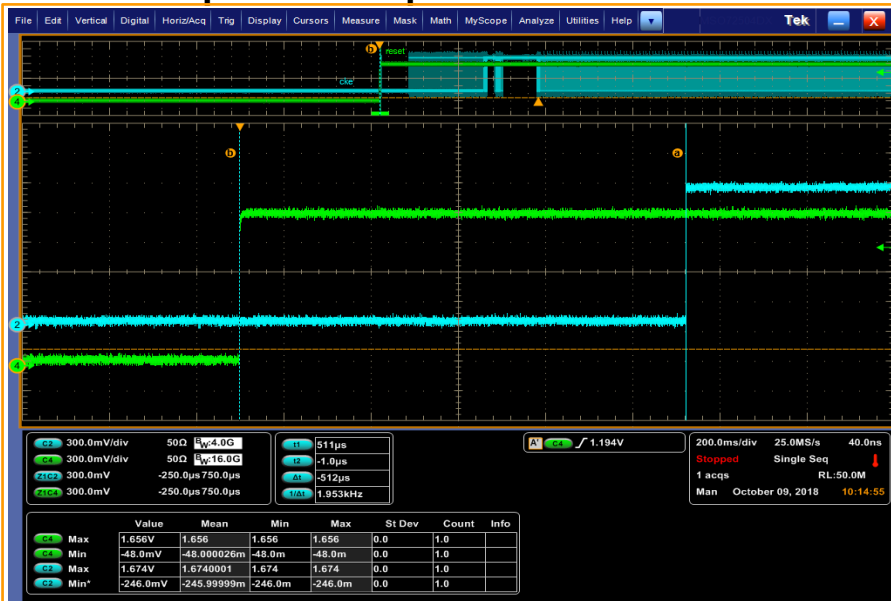


Parameter	Time	Spec	Result	Remark
Stable VDD to /Reset Up	156ms	Min:200us	PASS	/RESET needs to be maintained for minimum 200us with stable power. (JEDEC spec.)

Power Up Initialization Sequence Check Result



□ /Reset Up To CKE Up



CH4-RESET
CH2-CKE

□ tCKSRX



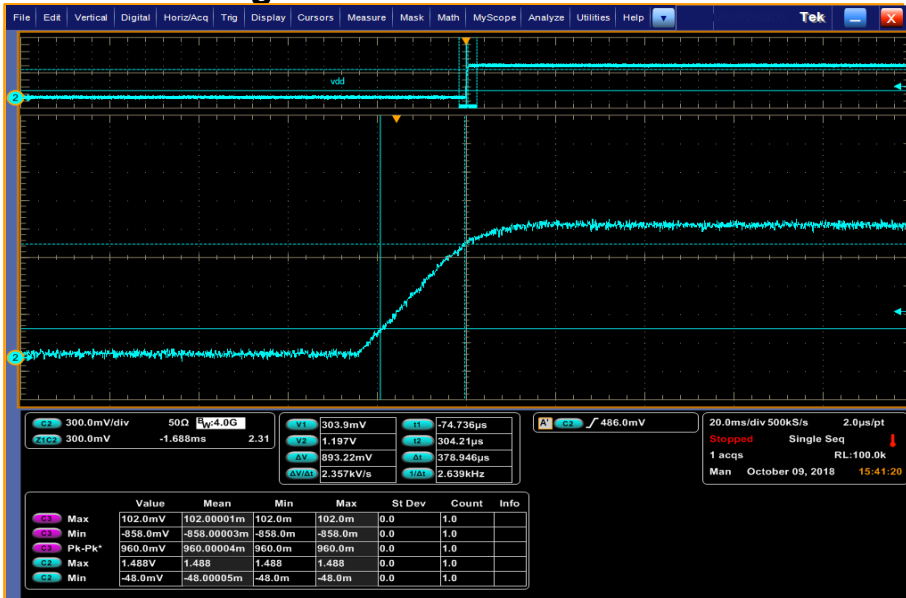
CH2-CKE
CH3-CK

Parameter	Time	Spec	Result	Remark
/Reset Up To CKE Up	512µs	Min:500µs	PASS	After /RESET is de-asserted. Wait for another 500µs until CKE becomes active.(JEDEC spec.)
tCKSRX	>30ns	Min: Max(5nCK,10ns)	PASS	Clocks (CK, CK#) need to be started and stabilized for at least 10 ns or 5 tCK (which is larger) before CKE goes active.(JEDEC spec.)

Power Up Initialization Sequence Check Result

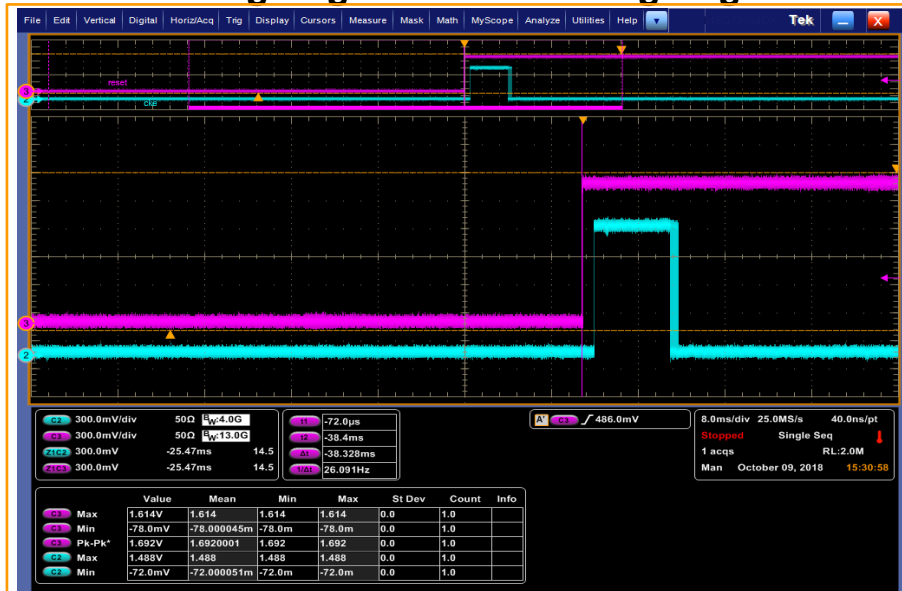


VDD Rising Time



CH2-VDD

CKE Falling Edge To Reset Rising Edge



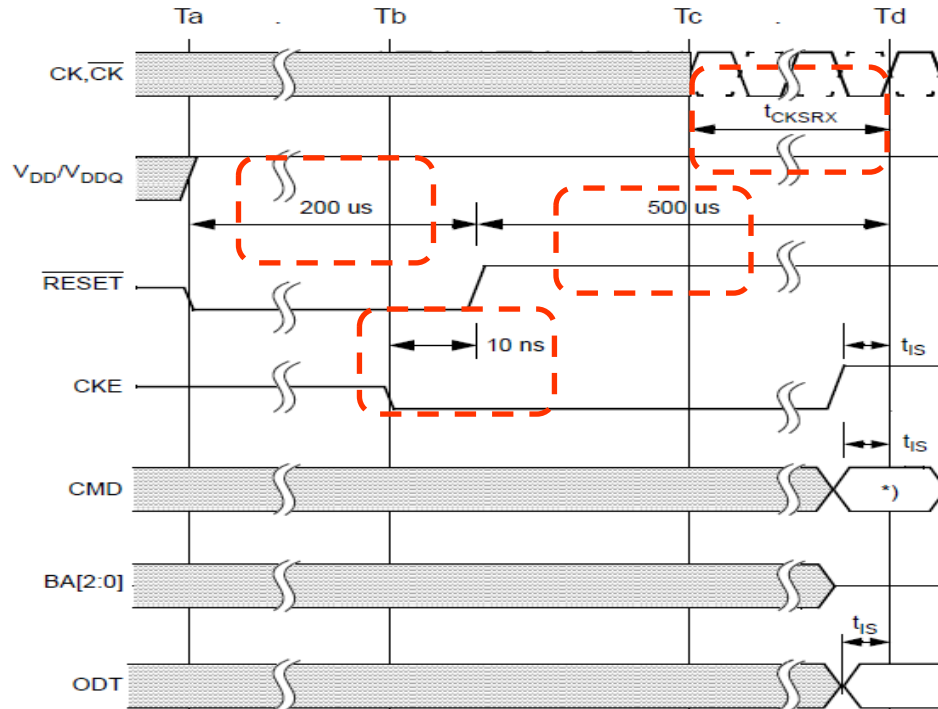
CH3-RESET
CH2-CKE

Parameter	Time	Spec	Result	Remark
VDD Rising Time	379us	Max:200ms	PASS	The power voltage ramp time between 300 mv to VDDmin must be no greater than 200 ms.(JEDEC spec.)
CKE Falling Edge to Reset Rising Edge	>38.4ms	Min:10ns	PASS	CKE is pulled "Low" anytime before RESET# being de-asserted (min. time 10 ns).

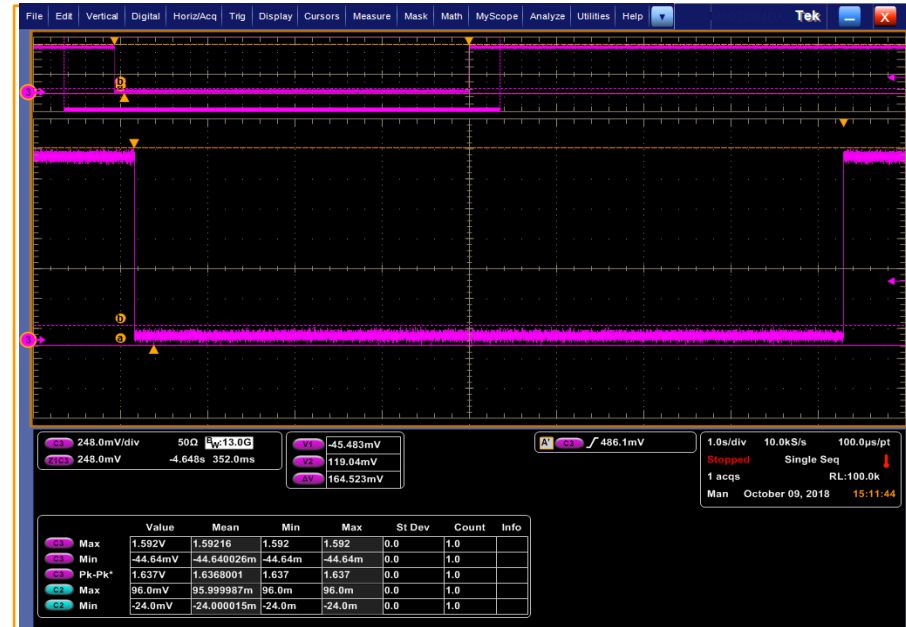


Reset Initialization Sequence Check Result

SPEC



Reset Low Level Voltage



CH3-RESET

Parameter	Voltage	Spec	Result	Remark
Reset Low Level Voltage	164.5mV	Max: 300mV	PASS	Reset Low Level Voltage must be within 300 mV.

Average Periodic Refresh Interval Check Result



□ SPEC

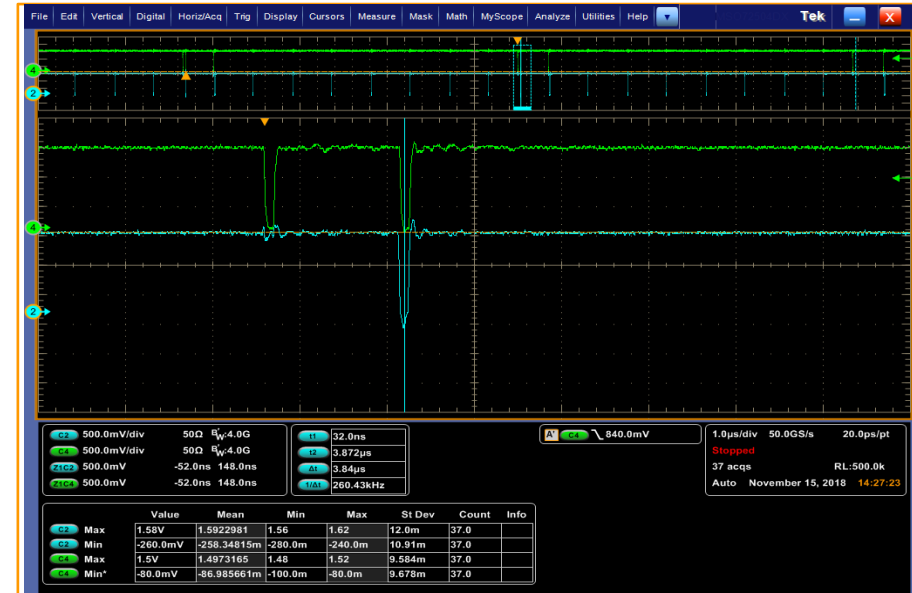
12.2 Refresh parameters by device density

Table 61 — Refresh parameters by device density

Parameter	Symbol	512Mb	1Gb	2Gb	4Gb	8Gb	Units	Notes
REF command to ACT or REF command time	tRFC	90	110	160	300	350	ns	
Average periodic refresh interval	tREFI	0 °C ≤ T _{CASE} ≤ 85 °C					7.8	μs
		85 °C < T _{CASE} ≤ 95 °C					3.9	μs

NOTE 1. Users should refer to the DRAM supplier data sheet and/or the DIMM SPD to determine if DDR3 SDRAM devices support the following options or requirements referred to in this material.

□ Average Periodic Refresh Interval



CH2-RASN
CH1-CASN

Parameter	Time	Spec	Result	Remark
tREFI	3.84us	Max:7.8us	PASS	



Power Check Result

▣ AC Peak-Peak Noise Check Result

Parameter	Spec (PK-PK)	Value (PK-PK)	Unit	Result	Position	Test Point
VDD_IO	NA	34	mV	NA	DRAM	C283
VREFCA	30	14.2	mV	PASS	DRAM	C153
VREFDQ	30	14.4	mV	PASS	DRAM	C156

▣ VDD_IO Supply Voltage

Parameter	Spec	Value	Unit	Result	Position	Test Point
VDD_IO	Min:1.283 Max:1.45	1.355	V	PASS	SOC	LB20
		1.356	V	PASS	DDR	R174



Signal Integrity Test Result (Clock)

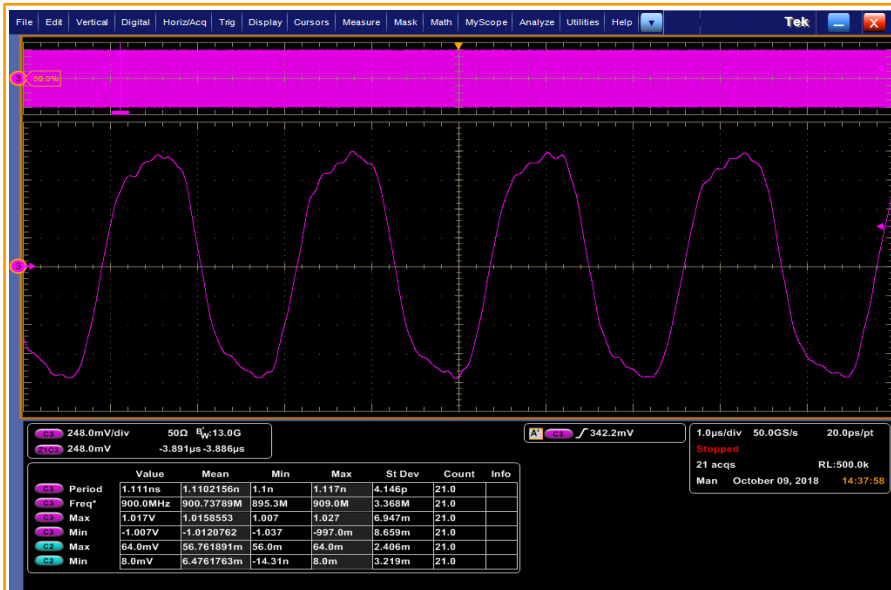
▣ Clock Signal Integrity Test Result

Parameter	Spec (Min)	Spec (Max)	Measurement data (Min)	Measurement data (Max)	Unit	Remark
Vix	-150	150	-114.33	93	mV	PASS
tCK(avg)	1.07	1.25	1.110	1.112	ps	PASS
tCH(avg)	470	530	506	508	mtCK(avg)	PASS
tCL(avg)	470	530	491	494	mtCK(avg)	PASS
tJIT(per)	-70	70	-17.3	20.5	ps	PASS
tJIT(cc)	-140	140	-15.5	18.8	ps	PASS
InputSlew-Diff-Rise	-	-	-	10.108	V/ns	-
InputSlew-Diff-Fall	-	-	-	-6.3436	V/ns	-



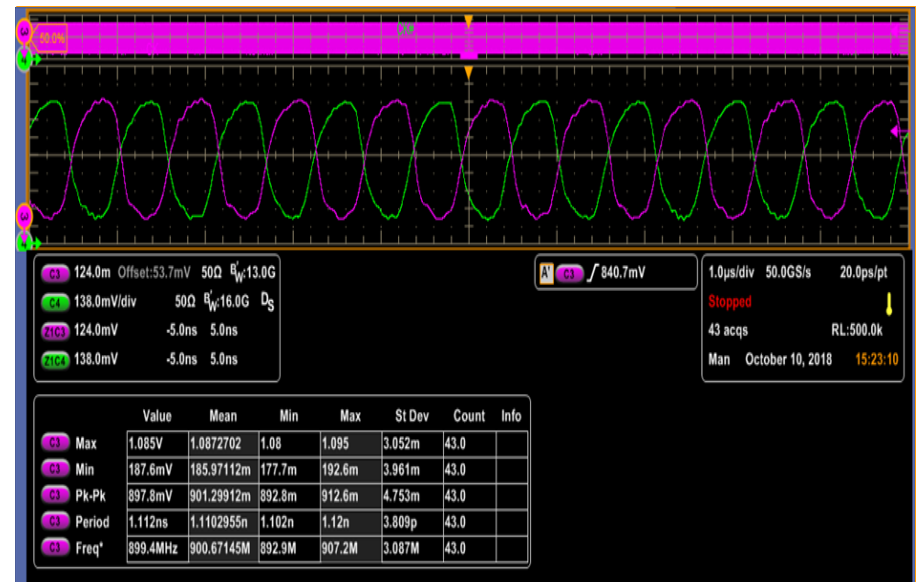
Signal Integrity Test Result (Clock)

▣ CLK With Differential Measurement



CH3 -CLK(Diff)

▣CLK Vix With High Voltage Trigger



CH4-CLK+
CH3-CLK-



Signal Integrity Test Result (CMD&ADDR)

■ SPEC

Symbol	Reference	DDR3-800	DDR3-1066	DDR3-1333	DDR3-1600	DDR3-1866	DDR3-2133	Units
tIS(base) AC175	$V_{IH/L(ac)}$	200	125	65	45	-	-	ps
tIS(base) AC150	$V_{IH/L(ac)}$	350	275	190	170	-	-	ps
tIS(base) AC135	$V_{IH/L(ac)}$	-	-	-	-	65	60	ps
tIS(base) AC125	$V_{IH/L(ac)}$	-	-	-	-	150	135	ps
tIH(base) DC100	$V_{IH/L(dc)}$	275	200	140	120	100	95	ps

$\Delta tIS, \Delta tIH$ derating in [ps] AC/DC based Alternate AC125 Threshold $\rightarrow V_{IH(ac)}=V_{REF(dc)}+135mV, V_{IL(ac)}=V_{REF(dc)}-135mV$																	
		CK,CK# Differential Slew Rate															
		4.0 V/ns		3.0 V/ns		2.0 V/ns		1.8 V/ns		1.6 V/ns		1.4 V/ns		1.2 V/ns		1.0 V/ns	
		ΔtIS	ΔtIH	ΔtIS	ΔtIH	ΔtIS	ΔtIH	ΔtIS	ΔtIH	ΔtIS	ΔtIH	ΔtIS	ΔtIH	ΔtIS	ΔtIH	ΔtIS	ΔtIH
CMD/ ADD Slew rate V/ns	2.0	68	50	68	50	68	50	76	58	84	66	92	74	100	84	108	100
	1.5	45	34	45	34	45	34	53	42	61	50	69	58	77	68	85	84
	1.0	0	0	0	0	0	0	8	8	16	16	24	24	32	34	40	50
	0.9	2	-4	2	-4	2	-4	10	4	18	12	26	20	34	30	42	46
	0.8	3	-10	3	-10	3	-10	11	-2	19	6	27	14	35	24	43	40
	0.7	6	-16	6	-16	6	-16	14	-8	22	0	30	8	38	18	46	34
	0.6	9	-26	9	-26	9	-26	17	-18	25	-10	33	-2	41	8	49	24
	0.5	5	-40	5	-40	5	-40	13	-32	21	-24	29	-16	37	-6	45	10
	0.4	-3	-60	-3	-60	-3	-60	6	-52	14	-44	22	-36	30	-26	38	-10



Signal Integrity Test Result (CMD&ADDR)

▣ Command Signal Integrity Test Result

CMD /ADD	Input Setup Time (tIS)@AC150 tIS(min)(ps)	Input Hold Time (tIH)@DC100 tIH(min) (ps)	Input Slew Rate (Rising Time) (V/ns)	Input Slew Rate (Falling Time) (V/ns)
SPEC	133	150		
CS_N	552	476	2.08	-3.16
ODT	533	491	2.25	-2.54



Signal Integrity Test Result (CMD&ADDR)

▣ 1T_CMD_ADDR CS_N



▣ 1T_CMD_ADDR ODT





Signal Integrity Test Result (CMD&ADDR)

Address Signal Integrity Test Result

CMD /ADD	Input SetupTime (tIS)@AC150 tIS(min)(ps)	Input Hold Time (tIH)@DC100 tIH(min) (ps)	Input Slew Rate (RisingTime) (V/ns)	Input Slew Rate (FallingTime) (V/ns)
SPEC	133	150		
A4	1001.5	1069.9	3.6	-2.4734
A7	1023.1	1042.7	3.6	-2.8045



Signal Integrity Test Result (CMD&ADDR)

□ 2T_CMD_ADDR A4



□ 2T_CMD_ADDR A7





Signal Integrity Test Result (DATA)

■ SPEC

Symbol	Reference	DDR3-800	DDR3-1066	DDR3-1333	DDR3-1600	DDR3-1866	DDR3-2133	Units	Notes
tDS(base) AC175	$V_{IH/L(ac)}$ SR=1V/ns	75	25	-	-	-	-	ps	2
tDS(base) AC150	$V_{IH/L(ac)}$ SR=1V/ns	125	75	30	10	-	-	ps	2
tDS(base) AC135	$V_{IH/L(ac)}$ SR=1V/ns	165	115	60	40			ps	2, 3
tDS(base) AC135	$V_{IH/L(ac)}$ SR=2V/ns	-	-	-	-	68	53	ps	1
tDH(base) DC100	$V_{IH/L(dc)}$ SR=1V/ns	150	100	65	45	-	-	ps	2
tDH(base)DC100	$V_{IH/L(dc)}$ SR=2V/ns					70	55	ps	1

$\Delta tDS, \Delta tDH$ derating in [ps] AC/DC based Alternate AC135 Threshold -> $V_{IH(ac)}=V_{REF(dc)}+135mV$, $V_{IL(ac)}=V_{REF(dc)}-135mV$ Alternate DC 100 Threshold -> $V_{IH(dc)}=V_{REF(dc)}+100mV$, $V_{IL(dc)}=V_{REF(dc)}-100mV$																									
		DQS,DQS# Differential Slew Rate																							
		8.0 V/ns		7.0 V/ns		6.0 V/ns		5.0 V/ns		4.0 V/ns		3.0 V/ns		2.0 V/ns		1.8 V/ns		1.6 V/ns		1.4 V/ns		1.2 V/ns		1.0 V/ns	
		ΔtDS	ΔtDH	ΔtDS	ΔtDH	ΔtDS	ΔtDH	ΔtDS	ΔtDH	ΔtDS	ΔtDH	ΔtDS	ΔtDH	ΔtDS	ΔtDH	ΔtDS	ΔtDH	ΔtDS	ΔtDH	ΔtDS	ΔtDH	ΔtDS	ΔtDH	ΔtDS	ΔtDH
DQS Slew rate V/ns	4.0	34	25	34	25	34	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3.5	29	21	29	21	29	21	29	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3.0	23	17	23	17	23	17	23	17	23	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2.5	-	-	14	10	14	10	14	10	14	10	14	10	-	-	-	-	-	-	-	-	-	-	-	-
	2.0	-	-	-	-	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-
	1.5	-	-	-	-	-	-	-23	-17	-23	-17	-23	-17	-23	-17	-15	-9	-	-	-	-	-	-	-	-
	1.0	-	-	-	-	-	-	-	-	-68	-50	-68	-50	-68	-50	-60	-42	-52	-34	-	-	-	-	-	-
	0.9	-	-	-	-	-	-	-	-	-	-	-66	-54	-66	-54	-58	-46	-50	-38	-42	-30	-	-	-	-
	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-64	-60	-56	-52	-48	-44	-40	-36	-32	-26	-	-
	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-53	-59	-45	-51	-37	-43	-29	-33	-21	-17
	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-43	-61	-35	-53	-27	-43	-19	-27
	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-39	-66	-31	-56	-23	-40
	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-38	-76	-30	-60



Signal Integrity Test Result (DATA)

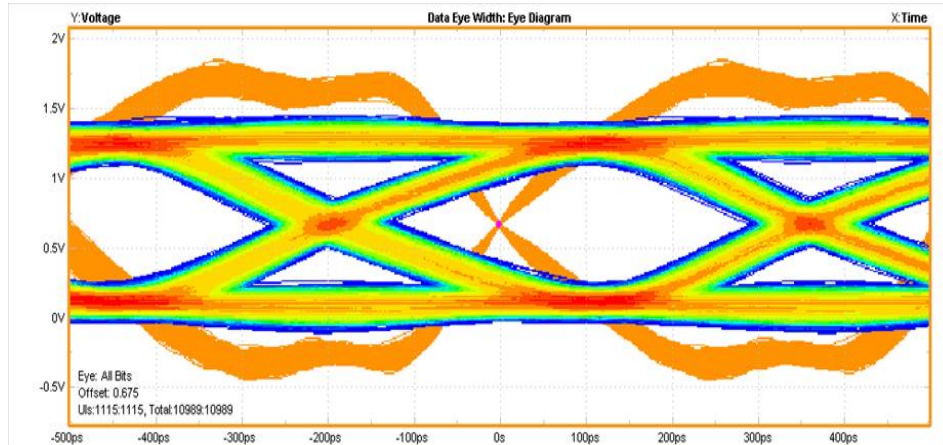
▣ Data Signal Integrity Test Result

Parameter	Spec	Unit	DQ7	DQ14	Remarks
Input Slew Rate(Setup-time)	-	V/ns	5.7	3.12	-
Input Slew Rate(Hold-time)	-	V/ns	-5.7	-3.51	-
Input Setup-Time(tDS)@AC135 [tDS(base)=68ps]	min:99	ps	128.65	107.41	PASS
Input Hold-Time(tDH)@DC100 [tDH(base)=70ps]	min:95	ps	214.09	241.41	PASS

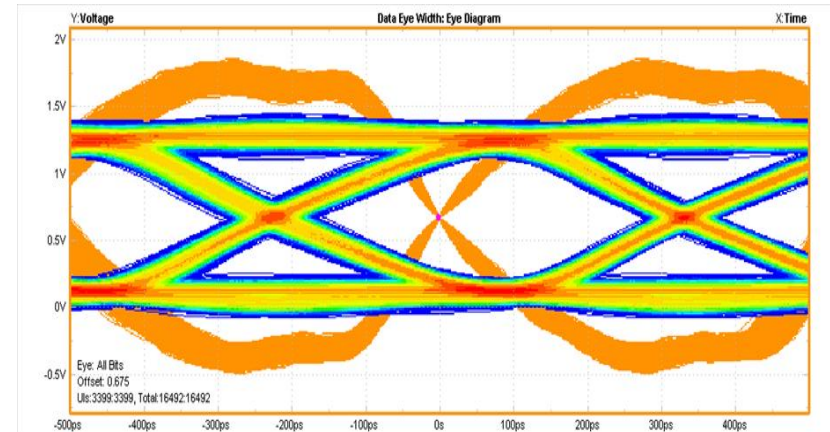


Signal Integrity Test Result (DATA)

▣ DQ7-Write



▣ DQ14-Write



■ **DDR Training write window**

[PHY0][RANK0]:
Write window of prebit-deskew:

DQ	0	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84	88	92	96	100	104	108	112	116	120	124	RANGE	DQPH	DQ	WIN
0	XX	-----	XX	0x00250067	0x8	70	67																													
1	XX	-----	XX	0x0020005e	0x8	63	63																													
2	XX	-----	XX	0x00220065	0x8	68	68																													
3	XX	-----	XX	0x00220065	0x8	68	68																													
4	XX	-----	XX	0x001b0059	0x8	58	63																													
5	XX	-----	XX	0x001a005b	0x8	59	66																													
6	XX	-----	XX	0x001c005d	0x8	61	66																													
7	XX	-----	XX	0x001c005b	0x8	60	64																													
8	XX	-----	XX	0x001c0059	0x8	59	62																													
9	XX	-----	XX	0x00230063	0x8	67	65																													
10	XX	-----	XX	0x00210063	0x8	66	67																													
11	XX	-----	XX	0x00170056	0x8	55	64																													
12	XX	-----	XX	0x001c0059	0x8	59	62																													
13	XX	-----	XX	0x00220060	0x8	65	63																													
14	XX	-----	XX	0x00270063	0x8	69	61																													
15	XX	-----	XX	0x00210061	0x8	65	65																													

Sum WIN: 1034. Avg WIN: 64
Min WIN: 61. DQ Index: 14
Max WIN: 68. DQ Index: 2 3

DDR Training-read window

Read window of prebit-deskew:

DQ	0	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84	88	92	96	100	104	108	112	116	120	124	RANGE	DQS	DQ	WIN
0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												0x00240065	0x35	69	66								
1	XXXXXXXXXXXXXXXXXXXXXXXXXXXX												XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												0x001d005d	0x35	61	65								
2	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												0x00230065	0x35	68	67								
3	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												0x00260067	0x35	71	66								
4	XXXXXXXXXXXXXXXXXXXXXXXXXXXX												XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												0x00190059	0x35	57	65								
5	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												0x001c005b	0x35	60	64								
6	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												0x0021005f	0x35	64	63								
7	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												0x001e005c	0x35	61	63								
8	XXXXXXXXXXXXXXXXXXXXXXXXXXXX												XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												0x001d005b	0x38	60	63								
9	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												0x00280066	0x38	71	63								
10	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												0x00270067	0x38	71	65								
11	XXXXXXXXXXXXXXXXXXXXXXXXXXXX												XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												0x001b0058	0x38	58	62								
12	XXXXXXXXXXXXXXXXXXXXXXXXXXXX												XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												0x001d0059	0x38	59	61								
13	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												0x00220060	0x38	65	63								
14	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												0x00240060	0x38	66	61								
15	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX												0x00240061	0x38	67	62								

Sum WIN: 1019. Avg WIN: 63

Min WIN: 61. DQ Index: 12 14

Max WIN: 67. DQ Index: 2



Thank you