



Product Specifications

PART NO:

VL393T2950E-E6/D5/CC

REV: 1.5

General Information

1GB 128Mx72 DDR2 SDRAM REGISTERED 240 PIN ECC DIMM

Description: The VL393T2950E is a 128M X 72 DDR2 SDRAM high density DIMM. This memory module consists of eighteen CMOS 128MX4 bit with 4 banks DDR2 Synchronous DRAMs in BGA packages, two 25-bit Registered buffers in BGA package, a zero delay PLL clock in BGA package, and a 2K EEPROM in 8-pin TSSOP package. This module is a 240-pin Dual-In line-Memory Module and is intended for mounting into a connector socket. Decoupling capacitors are mounted on the printed circuit board for each DDR2 SDRAM.

Features:

- . 240 -pin, dual-in line memory module (DIMM)
- . Fast data transfer rate: PC2-5300, PC2-4200, and PC2-3200
- . Supports ECC error detection and correction
- . VDD = VDDQ = 1.8V
- . VDDSPD = 1.7V to 3.6V
- . JEDEC standard 1.8V I/O (SSTL_18 compatible)
- . Differential data strobe (DQS, DQS#) option
- . Four-bit prefetch architecture
- . DLL aligns DQ and DQS transition with CK
- . Support duplicate output strobe (RDQS/RDQS#)
- . Programmable CAS# Latency (CL): 3, 4, and 5
- . Write latency = Read latency - 1 tCK
- . Programmable Burst ; length (4, 8)
- . Adjustable data-output drive strength
- . On-die termination (ODT)
- . Serial presence detect with EEPROMxc
- . Gold edge contacts
- . Lead-free RoHS
- . PCB: **Height 18.29mm (0.720")**, double sided component
- . Average refresh period 7.8us at lower TCASE = 85°C, 39us at 85°C < TCASE <= 95°C

Pin Name	Function
A0~A13	Address Inputs
BA0 ~ BA1	Bank Address Inputs
DQ0 ~ DQ63	Data Input/Output
CB0 ~ CB7	Check Bits
DQS0 ~ DQS17	Data Strobes
DQS0# ~ DQS17#	Data Strobes Complement
ODT0	On-die Termination Control
CK0,CK0#	Differential Clock Input
CKE0	Clock Enables
CS0#	Chip Selects
RAS#	Row Address Strobes
CAS#	Column Address Strobes
WE#	Write Enable
RESET#	Register Reset Input
VDD	Voltage Supply 1.8V +/- 0.1V
VDDQ	IO Power 1.8V +/- 0.1V
VSS	Ground
SA0~SA2	SPD Address
SDA	SPD Data Input/Output
SCL	SPD Clock Input
A10/AP	Address input/Autoprecharge
VREF	SSTL_18 Reference Voltage
VDDSPD	SPD Voltage supply 1.7V to 3.6V
NC	No Connect

Order Information:

VL393T2950E-E6 S

DRAM MANUFACTURER
S - SAMSUNG
M - MICRON

MODULE SPEED
E6: PC5300 @ CL5
D5: PC4200 @ CL4
CC: PC3200 @ CL3

VL : Lead-free/RoHS



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Pin Configuration

240-PIN DDR2 SODIMM FRONT								240-PIN DDR2 SODIMM BACK							
Pin	Name	Pin	Name	Pin	Name	Pin	Name	Pin	Name	Pin	Name	Pin	Name		
1	VREF	31	DQ19	61	A4	91	VSS	121	VSS	151	VSS	181	VDDQ	211	DQS14
2	VSS	32	VSS	62	VDDQ	92	DQS5#	122	DQ4	152	DQ28	182	A3	212	DQS14#
3	DQ0	33	DQ24	63	A2	93	DQS5	123	DQ5	153	DQ29	183	A1	213	VSS
4	DQ1	34	DQ25	64	VDD	94	VSS	124	VSS	154	VSS	184	VDD	214	DQ46
5	VSS	35	VSSD	65	VSS	95	DQ42	125	DQS9	155	DQS12	185	CK0	215	DQ47
6	DQS0#	36	DQS3#	66	VSS	96	DQ43	126	DQS9#	156	DQS12#	186	CK0#	216	VSS
7	DQS0	37	DQS3	67	VDD	97	VSS	127	VSS	157	VSS	187	VDD	217	DQ52
8	VSS	38	VSS	68	NC	98	DQ48	128	DQ6	158	DQ30	188	A0	218	DQ53
9	DQ2	39	DQ26	69	VDD	99	DQ49	129	DQ7	159	DQ31	189	VDD	219	VSS
10	DQ3	40	DQ27	70	A10/AP	100	VSS	130	VSS	160	VSS	190	BA1	220	NC
11	VSS	41	VSS	71	BA0	101	SA2	131	DQ12	161	CB4	191	VDDQ	221	NC
12	DQ8	42	CB0	72	VDDQ	102	NC	132	DQ13	162	CB5	192	RAS#	222	VSS
13	DQ9	43	CB1	73	WE#	103	VSS	133	VSS	163	VSS	193	CS0#	223	DQS15
14	VSS	44	VSS	74	CAS#	104	DQS6#	134	DQS10	164	DQS17	194	VDDQ	224	DQS15#
15	DQS1#	45	DQS8#	75	VDDQ	105	DQS6	135	DQS10#	165	DQS17#	195	ODT0	225	VSS
16	DQS1	46	DQS8	76	CS1#*	106	VSS	136	VSS	166	VSS	196	A13	226	DQ54
17	VSS	47	VSS	77	ODT1*	107	DQ50	137	NC	167	CB6	197	VDD	227	DQ55
18	RESET#	48	CB2	78	VDDQ	108	DQ51	138	NC	168	CB7	198	VSS	228	VSS
19	NC	49	CB3	79	VSS	109	VSS	139	VSS	169	VSS	199	DQ36	229	DQ60
20	VSS	50	VSS	80	DQ32	110	DQ56	140	DQ14	170	VDDQ	200	DQ37	230	DQ61
21	DQ10	51	VDDQ	81	DQ33	111	DQ57	141	DQ15	171	CKE1*	201	VSS	231	VSS
22	DQ11	52	CKE0	82	VSS	112	VSS	142	VSS	172	VDD	202	DQS13	232	DQS16
23	VSS	53	VDD	83	DSQ4#	113	DQS7#	143	DQ20	173	NC	203	DQS13#	233	DQS16#
24	DQ16	54	BA2*	84	DSQ4	114	DQS7	144	DQ21	174	NC	204	VSS	234	VSS
25	DQ17	55	NC	85	VSS	115	VSS	145	VSS	175	VDDQ	205	DQ38	235	DQ62
26	VSS	56	VDDQ	86	DQ34	116	DQ58	146	DQS11	176	A12	206	DQ39	236	DQ63
27	DQS2#	57	A11	87	DQ35	117	DQ59	147	DQS11#	177	A9	207	VSS	237	VSS
28	DQS2	58	A7	88	VSS	118	VSS	148	VSS	178	VDD	208	DQ44	238	VDDSPD
29	VSS	59	VDD	89	DQ40	119	SDA	149	DQ22	179	A8	209	DQ45	239	SA0
30	DQ18	60	A5	90	DQ41	120	SCL	150	DQ23	180	A6	210	VSS	240	SA1

* These pins are not used in this module.



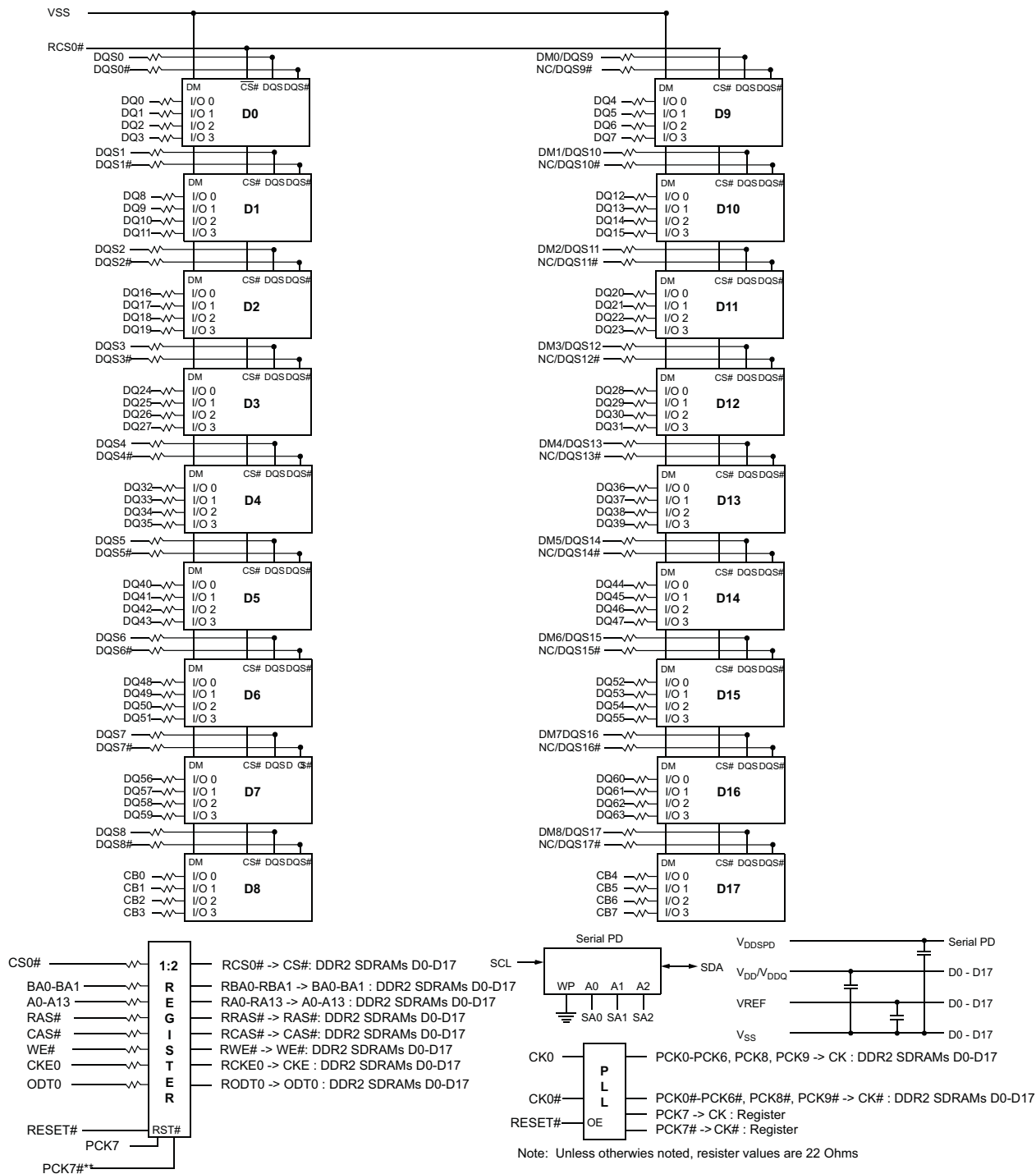
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Functional Block Diagram





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Absolute Maximum Ratings

Symbol	Parameter	MIN	MAX	Unit	
VDD	Voltage on VDD pin relative to Vss	-1.0	2.3	V	
VDDQ	Voltage on VDDQ pin relative to Vss	-0.5	2.3	V	
VDDL	Voltage on VDDL pin relative to Vss	-0.5	2.3	V	
VIN, VOUT	Voltage on any pin relative to Vss	-0.5	2.3	V	
TSTG	Storage temperature	-55	100	°C	
TCASE	Device operating Temperature	0	95 ⁽¹⁾	°C	
I _L	Input leakage current; Any input 0V<VIN<VDD; VREF input 0V<VIN<0.95V; Other pins not under test = 0V	Command/Address, RAS#, CAS#, WE# CS#, CKE	-5	5	uA
		CK, CK#	-10	10	uA
		DM	-5	5	uA
I _{oz}	Output leakage current; 0V<VOUT<VDDQ; DQs and ODT are disable	-5	5	uA	
I _{VREF}	VREF leakage current; VREF = Valid VREF level	-36	36	uA	

Note:
1. TCASE = 85°C - 95°C: Average refresh period = 39us

DC Operating Conditions

All voltages referenced to VSS

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Supply voltage	VDD	1.7	1.8	1.9	V	1
I/O Supply voltage	VDDQ	1.7	1.8	1.9	V	4
VDDL Supply voltage	VDDL	1.7	1.8	1.9	V	4
I/O Reference voltage	VREF	0.49 x VDDQ	0.50 x VDDQ	0.51 x VDDQ	V	2
I/O Termination voltage	VTT	VREF-0.04	VREF	VREF+0.04	V	3

Notes: 1. VDD, VDDQ must track each other. VDDQ must be less than or equal to VDD.
2. VREF is expected to equal VDDQ/2 of the transmitting device and to track variations in the DC level of the same. Peak-to-peak noise on VREF may not exceed +/-1percent of the DC value. Peak-to-peak AC noise on VREF may not exceed +/-2 percent of VREF. This measurement is to be taken at the nearest VREF bypass capacitor.
3. VTT is not applied directly to the device. VTT is a system supply for signal termination resistors, is expected to be set equal to VREF and must track variations in the DC level of VREF.
4. VDDQ tracks with VDD; VDDL track with VDD.



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Operating Temperature Condition

Parameter	Symbol	Rating	Units	Notes
Operating temperature	T _{OPER}	0 to 95	°C	1,2,3

Notes:

1. Operating temperature is the case surface temperature on the center/top side of the DRAM. For the measurement conditions, please refer to JEDEC JESD51.2
2. At 0 - 95°C, operation temperature range, all DRAM specification will be supported.
3. T_{CASE} = 85°C - 95°C: Average refresh period = 39us

Input DC Logic Level

All voltages referenced to VSS

Parameter	Symbol	Min	Max	Unit
Input High (Logic 1) Voltage	V _{IH} (DC)	VREF + 0.125	VDDQ + 0.300	V
Input Low (Logic 0) Voltage	V _{IL} (DC)	-0.300	VREF - 0.125	V

Input AC Logic Level

All voltages referenced to VSS

Parameter	Symbol	Min	Max	Unit
AC Input High (Logic 1) Voltage	V _{IH} (AC)	VREF + 0.250	-	V
AC Input Low (Logic 0) Voltage	V _{IL} (AC)	-	VREF - 0.250	V

Input/Output Capacitance

T_A=25°C, f=100MHz

Parameter	Symbol	Min	Max	Unit
Input capacitance (A0~A13, BA0~BA1,RAS#,CAS#,WE#)	CIN1	11	12	pF
Input capacitance (CKE0), (ODT0)	CIN2	11	12	pF
Input capacitance (CS0#)	CIN3	11	12	pF
Input capacitance (CK0, CK0#)	CIN4	10	11	pF
Input capacitance (DM0 ~ DM8)	CIN5 (E6)	6.5	7.5	pF
	CIN5 (D5,CC)	6.5	8	
Input capacitance (DQ0 ~ DQ63), (DQS0 ~ DQS17)	COU1 (E6)	6.5	7.5	pF
	COU1 (D5,CC)	6.5	8	



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IDD Specification

Condition	Symbol	-E6	-D5	-CC	Unit
Operating one bank active-precharge; $t_{CK} = t_{CK(DD)}$; $t_{RC} = t_{RC(DD)}$; $t_{RAS} = t_{RAS MIN(DD)}$; CKE is HIGH, CS# is HIGH between valid commands; Address bus inputs are SWITCHING; Data bus inputs are SWITCHING	IDD0	1750	1750	1660	mA
Operating one bank active-read-precharge; IOUT = 0mA; BL = 4; CL = CL(DD); $t_{CK} = t_{CK(DD)}$; $t_{RC} = t_{RC(DD)}$; $t_{RAS} = t_{RAS MIN(DD)}$; CKE is HIGH, CS# is HIGH between valid commands; Address bus inputs are SWITCHING; Data bus inputs are SWITCHING; Data pattern is same as IDD4W.	IDD1	1930	1930	1930	mA
Precharge power-down current; All banks idle; $t_{CK} = t_{CK(DD)}$; CKE is LOW; Other control and address bus inputs are STABLE; Data bus inputs are FLOATING	IDD2P	544	544	544	mA
Precharge quite standby current; All banks idle; $t_{CK} = t_{CK(DD)}$; CKE is HIGH; CS# is HIGH; Other control and address bus inputs are STABLE; Data bus inputs are FLOATING	IDD2Q	1030	940	940	mA
Precharge standby current; All banks idle; $t_{CK} = t_{CK(DD)}$; CKE is HIGH; CS# is HIGH; Other control and address bus inputs are STABLE; Data bus inputs are SWITCHING.	IDD2N	1120	1030	1030	mA
Active power-down current; All banks open; $t_{CK} = t_{CK(DD)}$; CKE is LOW; Other control and address bus inputs are STABLE; Data bus inputs are FLOATING.	Fast PDN Exit MRS(12) = 0mA Slow PDN Exit MRS(12) = 1mA	940	940	940	mA
		616	616	616	mA
Active standby current; All banks open; $t_{CK} = t_{CK(DD)}$; $t_{RC} = t_{RC(DD)}$; $t_{RAS} = t_{RAS MIN(DD)}$; CKE is HIGH, CS# is HIGH between valid commands; Other control and address bus inputs are SWITCHING; Data bus inputs are SWITCHING.	IDD3N	1390	1300	1300	mA
Operating burst write current; All banks open; Continuous burst writes; BL = 4; CL = CL(DD); AL = 0; $t_{CK} = t_{CK(DD)}$; $t_{RAS} = t_{RAS MAX(DD)}$; $t_{RP} = t_{RP(DD)}$; CKE is HIGH, CS# is HIGH between valid commands; Address bus inputs are SWITCHING; Data bus inputs are SWITCHING.	IDD4W	2290	2020	1840	mA
Operating burst read current; All banks open; Continuous burst reads; IOUT = 0mA; BL = 4; CL = CL(DD); AL = 0; $t_{CK} = t_{CK(DD)}$; $t_{RAS} = t_{RAS MAX(DD)}$; $t_{RP} = t_{RP(DD)}$; CKE is HIGH, CS# is HIGH between valid commands; Address bus inputs are SWITCHING; Data pattern is same as IDD4W.	IDD4R	2470	2200	2020	mA
Burst auto refresh current; $t_{CK} = t_{CK(DD)}$; Refresh command at every $t_{RFC(DD)}$ interval; CKE is HIGH; CS# is HIGH between valid commands; Other control and address bus inputs are SWITCHING; Data bus inputs are SWITCHING.	IDD5	2380	2290	2290	mA
Self refresh current; CK and CK# at 0V; CKE < 0.2V; Other control and address bus inputs are FLOATING; Data bus inputs are FLOATING.	Normal IDD6	144	144	144	mA
Operating bank interleave read current; All bank interleaving reads; IOUT = 0mA; BL = 4; CL = CL(DD); AL = $t_{RCD(DD)} - 1 * t_{CK(DD)}$; $t_{CK} = t_{CK(DD)}$; $t_{RC} = t_{RC(DD)}$; $t_{RRD} = t_{RRD(DD)}$; $t_{RCD} = 1 * t_{CK(DD)}$; CKE is HIGH; CS# is HIGH between valid commands; Address bus inputs are STABLE during DESELECTs; Data bus inputs are SWITCHING.	IDD7	3640	3640	3640	mA
Note: IDDs were calculated using Samsung components. Other manufacturers' DRAMs may have different values.					



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AC Timing Parameters & Specifications

Parameter	Symbol	-E6		-D5		-CC		Unit		
		Min	Max	Min	Max	Min	Max			
Clock	Clock cycle time	CL=5	$t_{CK}(5)$	3000	8000	-	-	-	ps	
		CL=4	$t_{CK}(4)$	3750	8000	3,750	8,000	5,000	8,000	ps
		CL=3	$t_{CK}(3)$	5000	8000	5,000	8,000	5,000	8,000	ps
	CK high-level width	t_{CH}	0.45	0.55	0.45	0.55	0.45	0.55	t_{CK}	
	CK low-level width	t_{CL}	0.45	0.55	0.45	0.55	0.45	0.55	t_{CK}	
	Half clock period	t_{HP}	MIN (t_{CH}, t_{CL})		MIN (t_{CH}, t_{CL})		MIN (t_{CH}, t_{CL})		ps	
Clock jitter	t_{JIT}	-125	125	-125	125	-125	125	ps		
Data	DQ output access time from CK/CK#	t_{AC}	-450	+450	-500	+500	-600	+600	ps	
	Data-out high impedance window from CK/CK#	t_{HZ}		$t_{AC(MAX)}$		$t_{AC(MAX)}$		$t_{AC(MAX)}$	ps	
	Data-out low-impedance window from CK/CK#	t_{LZ}	$t_{AC(MIN)}$	$t_{AC(MAX)}$	$t_{AC(MIN)}$	$t_{AC(MAX)}$	$t_{AC(MIN)}$	$t_{AC(MAX)}$	ps	
	DQ and DM input setup time relative to DQS	t_{DS}	100		100		150			
	DQ and DM input hold time relative to DQS	t_{DH}	175		225		275			
	DQ and DM input pulse width (for each input)	t_{DIPW}	0.35		0.35		0.35		t_{CK}	
	Data hold skew factor	t_{OHS}		340		400		450	ps	
	DQ-DQS hold, DQS to first DQ to go nonvalid, per access	t_{QH}	$t_{HP} - t_{QHS}$		$t_{HP} - t_{QHS}$		$t_{HP} - t_{QHS}$		ps	
	Data valid output window (DVW)	t_{DVW}	$t_{QH} - t_{DQSQ}$		$t_{QH} - t_{DQSQ}$		$t_{QH} - t_{DQSQ}$		ns	
Data Strobe	DQS input high pulse width	t_{DQSH}	0.35		0.35		0.35		t_{CK}	
	DQS input low pulse width	t_{DQSL}	0.35		0.35		0.35		t_{CK}	
	DQS output access time from CK/CK#	t_{DQSQCK}	-400	+400	-450	+450	-500	+500	ps	
	DQS falling edge to CK rising – setup time	t_{DSS}	0.2		0.2		0.2		t_{CK}	
	DQS falling edge from CK rising – hold time	t_{DSH}	0.2		0.2		0.2		t_{CK}	
	DQS-DQ skew, DQS to last DQ valid, per group, per access	t_{DQSQ}		240		300		350	ps	
	DQS read preamble	t_{RPRE}	0.9	1.1	0.9	1.1	0.9	1.1	t_{CK}	
	DQS read postamble	t_{RPST}	0.4	0.6	0.4	0.6	0.4	0.6	t_{CK}	
	DQS write preamble setup time	t_{WPRES}	0		0		0		ps	
	DQS write preamble	t_{WPRE}	0.35		0.35		0.35		t_{CK}	
	DQS write postamble	t_{WPST}	0.4	0.6	0.4	0.6	0.4	0.6	t_{CK}	
	Write command to first DQS latching transition	t_{DQSS}	WL-0.25	WL+0.25	WL-0.25	WL+0.25	WL-0.25	WL+0.25	t_{CK}	



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AC Timing Parameters & Specifications (cont')

	Parameter	Symbol	-E6		-D5		-CC		Unit
			Min	Max	Min	Max	Min	Max	
Command and Address	Address and control input pulse width for each input	t_{PW}	0.6		0.6		0.6		t_{CK}
	Address and control input setup time	t_{IS}	200		250		350		ps
	Address and control input hold time	t_{IH}	275		375		475		ps
	CAS# to CAS# command delay	t_{CCD}	2		2		2		ps
	ACTIVE to ACTIVE (same bank) command	t_{RC}	55		55		55		ns
	ACTIVE bank a to ACTIVE bank b command	t_{RRD}	7.5		7.5		7.5		ns
	ACTIVE to READ or WRITE delay	t_{RCD}	15		15		15		ns
	Four Bank Activate period	t_{FAW}	37.5	37.5	37.5	37.5	37.5	37.5	ns
	ACTIVE to PRECHARGE command	t_{RAS}	40	70,000	40	70,000	40	70,000	ns
	Internal READ to precharge command delay	t_{RTP}	7.5		7.5		7.5		ns
	Write recovery time	t_{WR}	15		15		15		ns
	Auto precharge write recovery + precharge time	t_{DAL}	$t_{WR}+t_{RP}$		$t_{WR}+t_{RP}$		$t_{WR}+t_{RP}$		ns
	Internal WRITE to READ command delay	t_{WTR}	7.5		7.5		10		ns
	PRECHARGE command period	t_{RP}	15		15		15		ns
	PRECHARGE ALL command period	t_{RPA}	$t_{RP}+t_{CK}$		$t_{RP}+t_{CK}$		$t_{RP}+t_{CK}$		ns
	LOAD MODE command cycle time	t_{MRD}	2		2		2		t_{CK}
CKE low to CK,CK# uncertainty	t_{DELAY}	$t_{IS}+t_{CK}+t_{IH}$		$t_{IS}+t_{CK}+t_{IH}$		$t_{IS}+t_{CK}+t_{IH}$		ns	
Self Refresh	REFRESH to Active or Refresh to Refresh command interval	t_{RFC}	105	70,000	105	70,000	105	70,000	ns
	Average periodic refresh interval	t_{REFI}		7.8		7.8		7.8	us
	Exit self refresh to non-READ command	t_{XSNR}	$t_{RFC(MIN)}+10$		$t_{RFC(MIN)}+10$		$t_{RFC(MIN)}+10$		ns
	Exit self refresh to READ	t_{XSRD}	200		200		200		t_{CK}
	Exit self refresh timing reference	t_{ISXR}	t_{IS}		t_{IS}		t_{IS}		ps
ODT	ODT turn-on delay	t_{AOND}	2	2	2	2	2	2	t_{CK}
	ODT turn-on	t_{AON}	$t_{AC(MIN)}$	$t_{AC(MAX)}^+700$	$t_{AC(MIN)}$	$t_{AC(MAX)}^+1000$	$t_{AC(MIN)}$	$t_{AC(MAX)}^+1000$	ps
	ODT turn-off delay	t_{AOFD}	2.5	2.5	2.5	2.5	2.5	2.5	t_{CK}
	ODT turn-off	t_{AOF}	$t_{AC(MIN)}$	$t_{AC(MAX)}^+600$	$t_{AC(MIN)}$	$t_{AC(MAX)}^+600$	$t_{AC(MIN)}$	$t_{AC(MAX)}^+600$	ps
	ODT turn-on (power-down mode)	t_{AONPD}	$t_{AC(MIN)}^+2000$	$2 \times t_{CK} + t_{AC(MAX)}^+1000$	$t_{AC(MIN)}^+2000$	$2 \times t_{CK} + t_{AC(MAX)}^+1000$	$t_{AC(MIN)}^+2000$	$2 \times t_{CK} + t_{AC(MAX)}^+1000$	ps
	ODT turn-off (power-down mode)	t_{AOFPD}	$t_{AC(MIN)}^+2000$	$2.5 \times t_{CK} + t_{AC(MAX)}^+1000$	$t_{AC(MIN)}^+2000$	$2.5 \times t_{CK} + t_{AC(MAX)}^+1000$	$t_{AC(MIN)}^+2000$	$2.5 \times t_{CK} + t_{AC(MAX)}^+1000$	ps
	ODT to power-down entry latency	t_{ANPD}	3		3		3		t_{CK}
	ODT power-down exit latency	t_{AXPD}	8		8		8		t_{CK}
Power-Down	Exit active power-down to READ command, MR[bit12=0]	t_{XARD}	2		2		2		t_{CK}
	Exit active power-down to READ command, MR[bit12=1]	t_{XARDS}	7-AL		6-AL		6-AL		t_{CK}
	Exit precharge power-down to any non-READ command.	t_{XP}	2		2		2		t_{CK}
	CKE minimum high/low time	t_{CKE}	3		3		3		t_{CK}

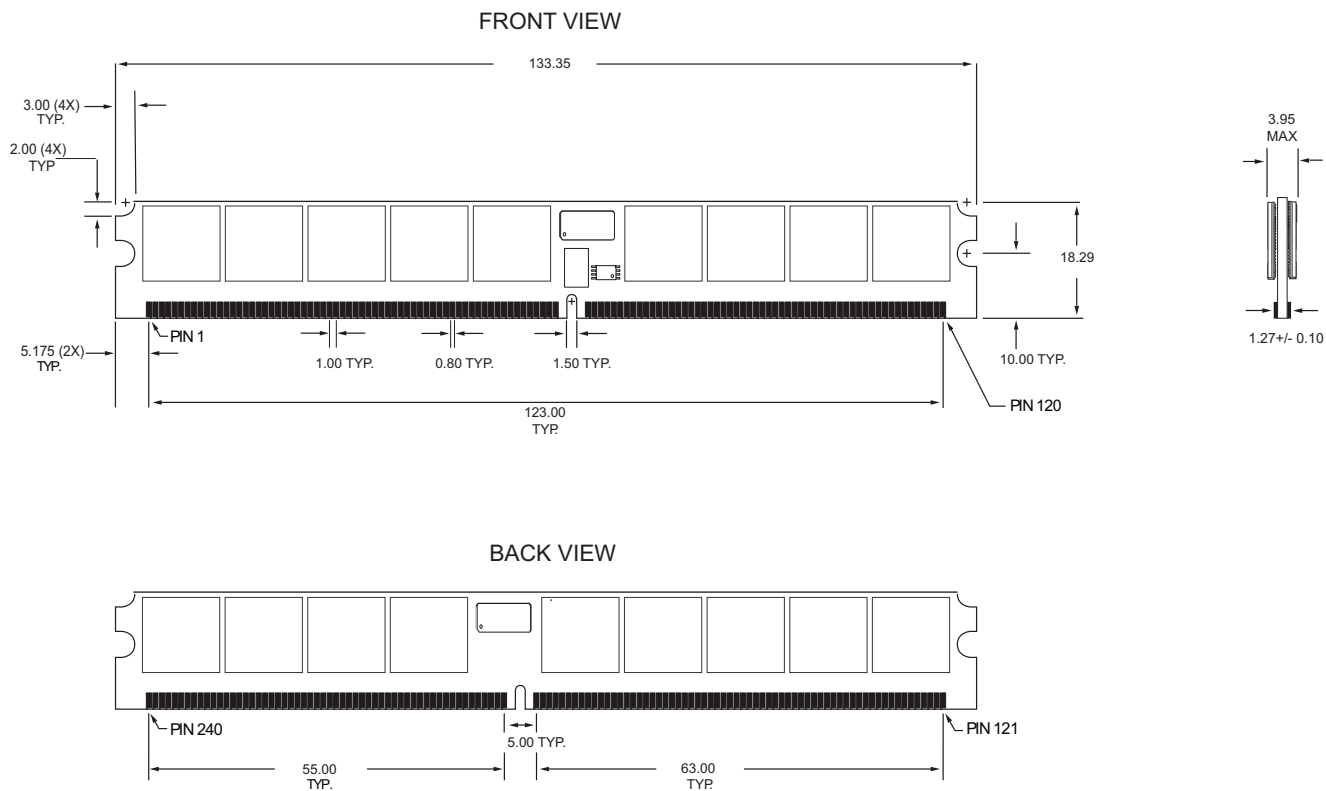
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Package Dimensions



NOTE:

All dimensions are in millimeters with tolerance +/- 0.13mm unless otherwise specified.



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Revision History:

Date	Rev.	Page	Changes
12/06/06	1.0	All	Released spec
03/05/08	1.4	All	Added speed DDR2-667 (E6), and updated Package Dimension (page 9)
05/12/08	1.5	9	Updated Dimension Package