



Product Specifications

PART NO:

VL391T5663A-E6/D5/CC

REV: 1.0

General Information

2GB 256Mx72 DDR2 SDRAM UNBUFFERED ECC 240 PIN DIMM

Description The VL391T5663A is a 256M X 72 DDR2 SDRAM high density DIMM. This memory module consists of eighteen CMOS 128MX8 bit with 8 banks DDR2 Synchronous DRAMs in BGA packages and a 2K EEPROM in an 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 rates: PC2-5300, PC2-4200, 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
- . Programmable CAS# Latency (CL): 3, 4, 5
- . Write latency = Read latency - 1 tCK
- . Programmable burst; length (4, 8)
- . Adjustable data-output drive strength
- . On-die termination (ODT)
- . Auto & self refresh, (8K/64ms refresh)
- . Serial presence detect (SPD) with EEPROM
- . Gold edge contacts
- . Lead-free RoHS
- . PCB: Height 30.00mm (1.181"), double sided components

Pin Name	Function
A0 ~ A13	Address Inputs
BA0 ~ BA2	Bank Address Inputs
DQ0 ~ DQ63	Data Input/Output
CB0 ~ CB7	Check Bits
DQS0 ~ DQS8	Data Strobes
DQS0# ~ DQS8#	Data Strobes Complement
ODT0, ODT1	On-die Termination Control
CK0,CK0# ~ CK2,CK2#	Differential Clock Input
CKE0, CKE1	Clock Enables
CS0#, CS1#	Chip Selects
RAS#	Row Address Strobes
CAS#	Column Address Strobes
WE#	Write Enable
VDD	Voltage Supply 1.8V +/- 0.1V
VDDQ	I/O Power 1.8V +/- 0.1V
VSS	Ground
SA0 ~ SA2	SPD Address
SDA	SPD Data Input/Output
SCL	SPD Clock Input
DM0 ~ DM8	Data Masks
A10/AP	Address Input/Autoprecharge
VREF	SSTL_18 Reference Voltage
VDDSPD	SPD Voltage Supply 1.7V to 3.6V
NC	No Connect

Order Information:

VL391T5663A-E6 S X

DRAM DIE (option)

DRAM MANUFACTURER
S - SAMSUNG
M - MICRON

MODULE SPEED
E6: PC2-5300 @ CL5
D5: PC2-4200 @ CL4
CC: PC2-3200 @ CL3

VL : Lead-free/RoHS



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Pin Configuration

240-PIN DDR2 DIMM FRONT								240-PIN DDR2 DIMM 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	DM5
2	VSS	32	VSS	62	VDDQ	92	DQS5#	122	DQ4	152	DQ28	182	A3	212	NC
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	DM0	155	DM3	185	CK0	215	DQ47
6	DQS0#	36	DQS3#	66	VSS	96	DQ43	126	NC	156	NC	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	CK2
11	VSS	41	VSS	71	BA0	101	SA2	131	DQ12	161	CB4	191	VDDQ	221	CK2#
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	DM6
14	VSS	44	VSS	74	CAS#	104	DQS6#	134	DM1	164	DM8	194	VDDQ	224	NC
15	DQS1#	45	DQS8#	75	VDDQ	105	DQS6	135	NC	165	NC	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	CK1	167	CB6	197	VDD	227	DQ55
18	NC	48	CB2	78	VDDQ	108	DQ51	138	CK1#	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	DM4	232	DM7
23	VSS	53	VDD	83	DSQ4#	113	DQS7#	143	DQ20	173	NC	203	NC	233	NC
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	DM2	176	A12	206	DQ39	236	DQ63
27	DQS2#	57	A11	87	DQ35	117	DQ59	147	NC	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



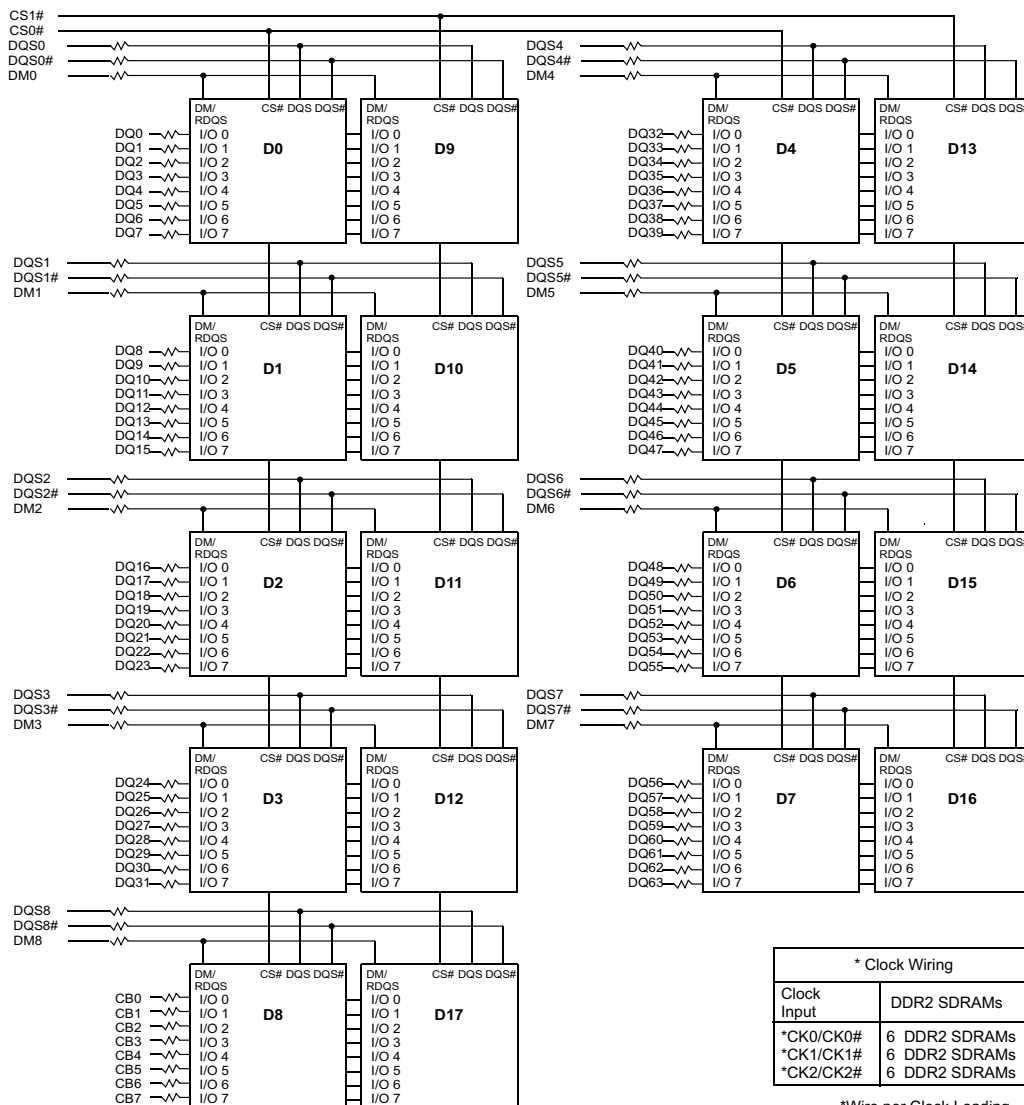
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Functional Block Diagram

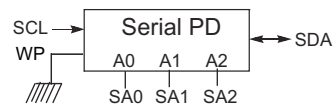
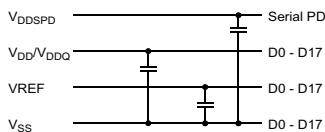


* Clock Wiring

Clock Input	DDR2 SDRAMs
*CK0/CK0#	6 DDR2 SDRAMs
*CK1/CK1#	6 DDR2 SDRAMs
*CK2/CK2#	6 DDR2 SDRAMs

*Wire per Clock Loading Table/Wiring Diagrams

- CS0# → CS0#: DDR2 SDRAMs D0-D8
- CS1# → CS1#: DDR2 SDRAMs D9-D17
- BA0-BA2 → BA0-BA2: DDR2 SDRAMs D0-D17
- A0-A13 → A0-A13: DDR2 SDRAMs D0-D17
- RAS# → RAS#: DDR2 SDRAMs D0-D17
- CAS# → CAS#: DDR2 SDRAMs D0-D17
- WE# → WE#: DDR2 SDRAMs D0-D17
- CKE0 → CKE0: DDR2 SDRAMs D0-D8
- CKE1 → CKE1: DDR2 SDRAMs D9-D17
- ODT0 → ODT0: DDR2 SDRAMs D0-D8
- ODT1 → ODT1: DDR2 SDRAMs D9-D17



Notes : Unless otherwise noted, resistor values are 22 Ohms +/- 5%



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Absolute Maximum Ratings

Symbol	Parameter	MIN	MAX	Unit	
V _{DD}	Voltage on V _{DD} pin relative to V _{SS}	-1.0	2.3	V	
V _{DDQ}	Voltage on V _{DDQ} pin relative to V _{SS}	-0.5	2.3	V	
V _{DDL}	Voltage on V _{DDL} pin relative to V _{SS}	-0.5	2.3	V	
V _{IN} , V _{OUT}	Voltage on any pin relative to V _{SS}	-0.5	2.3	V	
T _{STG}	Storage temperature	-55	100	°C	
T _{CASE}	Device operating temperature	0	85	°C	
I _L	Input leakage current; Any input 0V<V _{IN} <V _{DD} ; V _{REF} input 0V<V _{IN} <0.95V; Other pins not under test = 0V	Command/Address, RAS#, CAS#, WE#, BA	-90	90	µA
		CS#, CK, ODT	-45	45	µA
		CK, CK#	-30	30	µA
		DM	-10	10	µA
I _{oZ}	Output leakage current; 0V<V _{OUT} <V _{DDQ} ; DQs and ODT are disabled	-10	10	µA	
I _{VREF}	V _{REF} leakage current; V _{REF} = Valid V _{REF} level	-36	36	µA	

DC Operating Conditions

All voltages referenced to V_{SS}

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Supply voltage	V _{DD}	1.7	1.8	1.9	V	1
I/O Supply voltage	V _{DDQ}	1.7	1.8	1.9	V	4
VDDL Supply voltage	V _{DDL}	1.7	1.8	1.9	V	4
I/O Reference voltage	V _{REF}	0.49 x V _{DDQ}	0.50 x V _{DDQ}	0.51 x V _{DDQ}	V	2
I/O Termination voltage	V _{TT}	V _{REF} -0.04	V _{REF}	V _{REF} +0.04	V	3

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



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Operating Temperature Condition

Parameter	Symbol	Rating	Units	Notes
Operating temperature	TOPER	0 to 85	°C	1,2

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 - 85°C, operation temperature range, all DRAM specifications will be supported.

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 DDR2-533, DDR2-400	V _{IH} (AC)	VREF + 0.250	-	V
AC Input High (Logic 1) Voltage DDR2-667	V _{IH} (AC)	VREF + 0.200	-	V
AC Input Low (Logic 0) Voltage DDR2-533, DDR2-400	V _{IL} (AC)	-	VREF - 0.250	V
AC Input Low (Logic 0) Voltage DDR2-667	V _{IL} (AC)	-	VREF - 0.200	V

Input/Output Capacitance

TA=25°C, f=100MHz

Parameter	Symbol	Min	Max	Unit
Input capacitance (A0 ~ A13, BA0 ~ BA2, RAS#, CAS#, WE#)	CIN1	22	40	pF
Input capacitance (CKE0, CKE1), (ODT0, ODT1)	CIN2	22	40	pF
Input capacitance (CS0#, CS1#)	CIN3	13	22	pF
Input capacitance (CK0, CK0# ~ CK2, CK2#)	CIN4	10	16	pF
Input capacitance (DM0 ~ DM8), (CB0 ~ CB7)	CIN5	9	12	pF
Input capacitance (DQ0 ~ DQ63), (DQS0 ~ DQS8)	COU1	9	12	pF



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IDD Specification

Condition	Symbol	-E6	-D5	-CC	Unit
Operating one bank active-precharge; $t_{CK} = t_{CK(IDD)}$; $t_{RC} = t_{RC(IDD)}$; $t_{RAS} = t_{RAS MIN(IDD)}$; CKE is HIGH, CS# is HIGH between valid commands; Address bus inputs are SWITCHING; Data bus inputs are SWITCHING	IDD0*	900	855	810	mA
Operating one bank active-read-precharge; IOUT = 0mA; BL = 4; CL = CL(IDD); $t_{CK} = t_{CK(IDD)}$; $t_{RC} = t_{RC(IDD)}$; $t_{RAS} = t_{RAS MIN(IDD)}$; 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*	990	945	900	mA
Precharge power-down current; All banks idle; $t_{CK} = t_{CK(IDD)}$; CKE is LOW; Other control and address bus inputs are STABLE; Data bus inputs are FLOATING	IDD2P**	270	270	270	mA
Precharge quiet standby current; All banks idle; $t_{CK} = t_{CK(IDD)}$; CKE is HIGH; CS# is HIGH; Other control and address bus inputs are STABLE; Data bus inputs are FLOATING	IDD2Q**	720	720	630	mA
Precharge standby current; All banks idle; $t_{CK} = t_{CK(IDD)}$; CKE is HIGH; CS# is HIGH; Other control and address bus inputs are STABLE; Data bus inputs are SWITCHING.	IDD2N**	810	810	720	mA
Active power-down current; All banks open; $t_{CK} = t_{CK(IDD)}$; CKE is LOW; Other control and address bus inputs are STABLE; Data bus inputs are FLOATING.	Fast PDN Exit MRS(12) = 0 IDD3P**	720	630	630	mA
		Slow PDN Exit MRS(12) = 1	324	324	324
Active standby current; All banks open; $t_{CK} = t_{CK(IDD)}$; $t_{RC} = t_{RC(IDD)}$; $t_{RAS} = t_{RAS MIN(IDD)}$; CKE is HIGH, CS# is HIGH between valid commands; Other control and address bus inputs are SWITCHING; Data bus inputs are SWITCHING.	IDD3N**	1080	1080	990	mA
Operating burst write current; All banks open; Continuous burst writes; BL = 4; CL = CL(IDD); AL = 0; $t_{CK} = t_{CK(IDD)}$; $t_{RAS} = t_{RAS MAX(IDD)}$; $t_{RP} = t_{RP(IDD)}$; CKE is HIGH, CS# is HIGH between valid commands; Address bus inputs are SWITCHING; Data bus inputs are SWITCHING.	IDD4W*	1305	1215	1080	mA
Operating burst read current; All banks open; Continuous burst reads; IOUT = 0mA; BL = 4; CL = CL(IDD); AL = 0; $t_{CK} = t_{CK(IDD)}$; $t_{RAS} = t_{RAS MAX(IDD)}$; $t_{RP} = t_{RP(IDD)}$; CKE is HIGH, CS# is HIGH between valid commands; Address bus inputs are SWITCHING; Data pattern is same as IDD4W.	IDD4R*	1395	1305	1170	mA
Burst auto refresh current; $t_{CK} = t_{CK(IDD)}$; Refresh command at every $t_{RFC(IDD)}$ interval; CKE is HIGH; CS# is HIGH between valid commands; Other control and address bus inputs are SWITCHING; Data bus inputs are SWITCHING.	IDD5**	2700	2700	2610	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**	270	270	270	mA
Operating bank interleave read current; All bank interleaving reads; IOUT = 0mA; BL = 4; CL = CL(IDD); AL = $t_{RCD(IDD)} - 1 * t_{CK(IDD)}$; $t_{CK} = t_{CK(IDD)}$; $t_{RC} = t_{RC(IDD)}$; $t_{RRD} = t_{RRD(IDD)}$; $t_{RCD} = 1 * t_{CK(IDD)}$; CKE is HIGH; CS# is HIGH between valid commands; Address bus inputs are STABLE during DESELECTs; Data bus inputs are SWITCHING.	IDD7*	2295	2295	2160	mA

Note: IDD is based on Samsung D-die component. Other DRAM Manufacturer specification may be different.

*: Value calculated as one module rank in this operating condition, and all other module ranks in IDD2P (CKE LOW) mode.

** : Value calculated reflects all module ranks in this operating condition.



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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_{QHS}		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_{DQSCK}	-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_{DOSS}	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}	60		60		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}	45	70,000	45	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}	127.5	70,000	127.5	70,000	127.5	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}

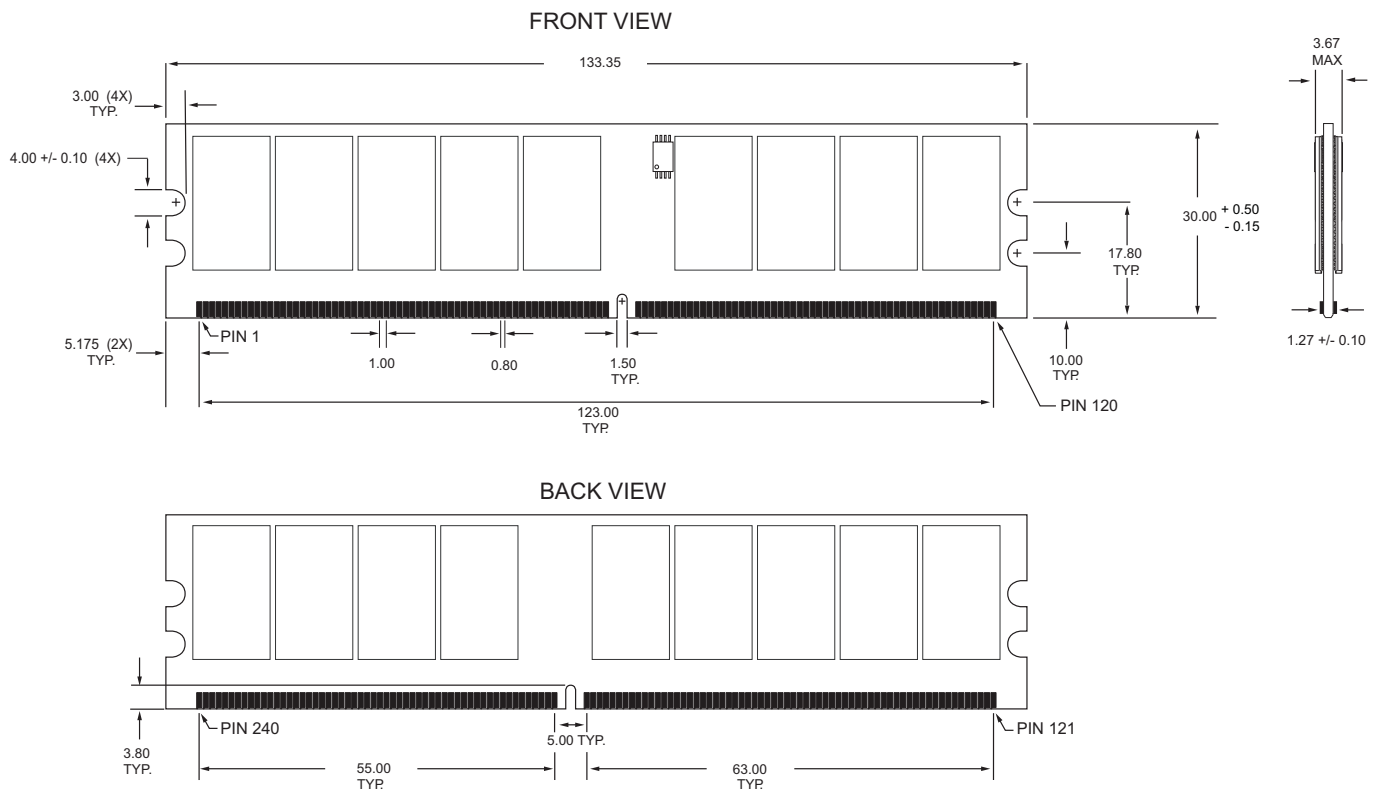
Product Specifications

PART NO:

VL391T5663A-E6/D5/CC

REV: 1.0

Package Dimensions



NOTE:

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



Product Specifications

PART NO:

VL391T5663A-E6/D5/CC

REV: 1.0

Revision History:

Date	Rev.	Page	Changes
03/05/09	0.1	All	Engineering Sample
07/15/09	1.0	All	Spec Release