



Product Specifications

PART NO:

VL493T1K66B-E6M/D5M/CCM

REV: 1.1

General Information

8GB 1Gx72 DDR2 SDRAM ECC SO-RDIMM 200-PIN WITH THERMAL SENSOR

Description

The VL493T1K66B is a 1Gx72 Double Data Rate DDR2 SDRAM high density SO-RDIMM. This memory module is four rank, consists of eighteen DDP CMOS 512Mx8 bit with 8 banks DDR2 Synchronous DRAMs in BGA packages, two 28-bit Registered buffers in BGA package, a zero delay PLL clock in BGA package, and two 2K EEPROMs with thermal sensor in an 8-pin MLF package. This module is a 200-pin small-outline dual in-line memory module and is intended for routing into an edge connector socket. Decoupling capacitors are mounted on the printed circuit board for each DDR2 SDRAM.

Features

- 200-pin, registered small-outline dual in-line memory module (SO-RDIMM)
- JEDEC pin out
- Supports ECC error detection and correction
- Fast data transfer rates: PC2-5300, PC2-4200, PC2-3200
- VDD = VDDQ = 1.8V
- JEDEC standard 1.8V (SSTL_18 compatible)
- VDDSPD = 3.0V to 3.6V
- Differential data strobe (DQS, DQS#) option
- Differential clock inputs (CK, CK#)
- Four-bit pre-fetch architecture
- DLL aligns DQ and DQS transition with CK
- Nominal and dynamic on-die termination (ODT)
- Programmable CAS# latency: 5 (DDR2-667), 4 (DDR2-533), 3 (DDR2-400)
- Write latency = Read latency - 1 tCK
- Eight internal component banks for concurrent operation
- Programmable burst; length (4, 8)
- Adjustable data-output drive strength
- Auto & self refresh, (8K/64ms refresh)
- Serial presence detect (SPD) with EEPROM built-in thermal sensor
- Thermal sensor range: -20°C to +125°C (+/- 1°C accuracy)
- Gold edge contacts
- Lead-free, RoHS compliant
- PCB: Height 34.29mm (1.350"), double sided component

Pin Description

Pin Name	Function
A0-A14	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
CK,CK#	Clock Input
CKE0,CKE1	Clock Enables
CS0#-CS3#	Chip Selects
RAS#	Row Address Strobes
CAS#	Column Address Strobes
WE#	Write Enable
RESET#	Register Reset Input
DM0-DM8	Data Masks
VDD	Voltage Supply 1.8V +/- 0.1V
A10/AP	Address Input/Auto Precharge
VDDSPD	SPD Voltage Supply 3.0V to 3.6V
VSS	Ground
SA1	SPD Address
SDA	SPD Data Input/Output
SCL	SPD Clock Input
VREF	SSTL_18 Reference Voltage
NC	No Connect

Order Information

VL493T1K66B-E6 M X

DRAM DIE (option)

DRAM MANUFACTURER
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

200-PIN DDR2 SO-RDIMM FRONT								200-PIN DDR2 SO-RDIMM BACK							
Pin	Name	Pin	Name	Pin	Name	Pin	Name	Pin	Name	Pin	Name	Pin	Name	Pin	Name
1	VREF	51	DQ18	101	VDD	151	VSS	2	VSS	52	VSS	102	A6	152	VSS
3	DQ0	53	DQ19	103	A5	153	DQS5#	4	DQ4	54	DQ28	104	A4	154	DM5
5	VSS	55	VSS	105	A3	155	DQS5	6	DQ5	56	DQ29	106	VDD	156	VSS
7	DQ1	57	DQ24	107	A2	157	VSS	8	VSS	58	VSS	108	A1	158	DQ46
9	DQS0#	59	DQ25	109	VDD	159	DQ42	10	DM0	60	DM3	110	A0	160	DQ47
11	DQS0	61	VSS	111	A10/AP	161	DQ43	12	VSS	62	VSS	112	BA1	162	VSS
13	VSS	63	DQS3#	113	BA0	163	VSS	14	DQ6	64	DQ30	114	VDD	164	DQ52
15	DQ2	65	DQS3	115	RAS#	165	DQ48	16	DQ7	66	DQ31	116	WE#	166	DQ53
17	DQ3	67	VSS	117	VDD	167	DQ49	18	VSS	68	VSS	118	CS0#	168	VSS
19	VSS	69	DQ26	119	CAS#	169	VSS	20	DQ12	70	CB4	120	ODT0	170	DM6
21	DQ8	71	DQ27	121	CS1#	171	DQS6#	22	DQ13	72	CB5	122	A13	172	VSS
23	DQ9	73	VSS	123	VDD	173	DQS6	24	VSS	74	VSS	124	VDD	174	DQ54
25	VSS	75	CB0	125	ODT1	175	VSS	26	DM1	76	DM8	126	CK	176	DQ55
27	DQS1#	77	CB1	127	CS3#	177	DQ50	28	VSS	78	VSS	128	CK#	178	VSS
29	DQS1	79	VSS	129	DQ32	179	DQ51	30	DQ14	80	CB6	130	VSS	180	DQ60
31	VSS	81	DQS8#	131	VSS	181	VSS	32	DQ15	82	CB7	132	DQ36	182	DQ61
33	DQ10	83	DQS8	133	DQ33	183	DQ56	34	VSS	84	VSS	134	DQ37	184	VSS
35	DQ11	85	VSS	135	DQS4#	185	DQ57	36	DQ20	86	CB2	136	VSS	186	DM7
37	VSS	87	CKE0	137	DQS4	187	VSS	38	DQ21	88	CB3	138	DM4	188	DQ62
39	DQ16	89	CKE1	139	VSS	189	DQS7#	40	VSS	90	VSS	140	VSS	190	VSS
41	DQ17	91	CS2#	141	DQ34	191	DQS7	42	RESET#	92	BA2	142	DQ38	192	DQ63
43	VSS	93	VDD	143	DQ35	193	DQ58	44	DM2	94	A14	144	DQ39	194	SDA
45	DQS2#	95	A12	145	VSS	195	VSS	46	VSS	96	A11	146	VSS	196	SCL
47	DQS2	97	A9	147	DQ40	197	DQ59	48	DQ22	98	VDD	148	DQ44	198	SA1
49	VSS	99	A7	149	DQ41	199	VDDSPD	50	DQ23	100	A8	150	DQ45	200	SA0*

Note:

*: These pins are not used in this module.

RESET (pin 42) RESET is connected to both OE of the PLL and Reset of the register.

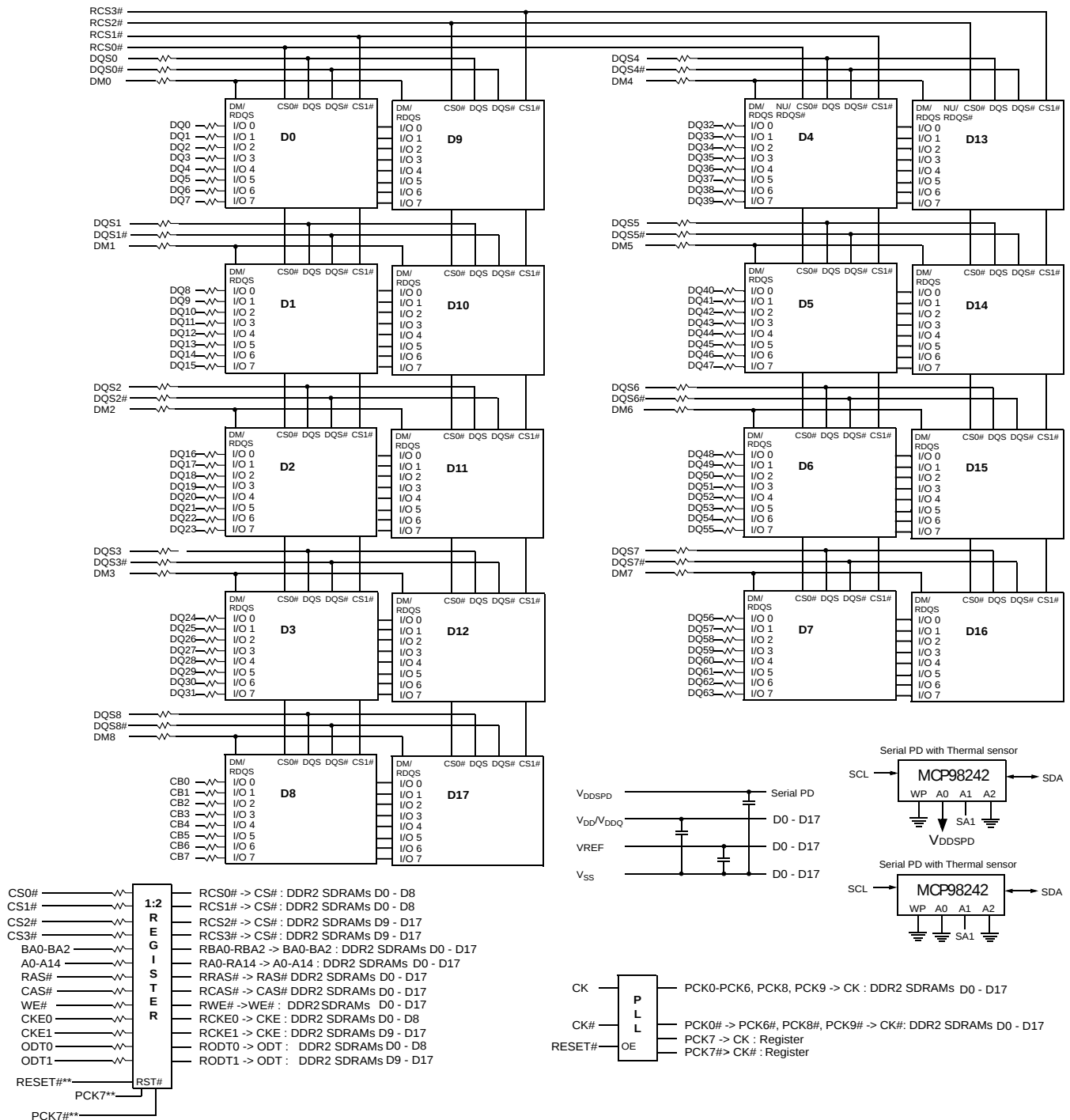
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Functional Block Diagram



Notes :

1. Unless otherwise noted, resistor values are 22 Ohms

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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	150	°C
I _L	Input leakage current; Any input 0V<V _{IN} <V _{DD} ; VREF input 0V<V _{IN} <0.95V; Other pins not under test = 0V	Command/Address, RAS#, CAS#, WE#, CE, ODT, BA	-5	5	μA
		CS#	-5	5	μA
		CK, CK#	-250	+250	μA
		DM	-20	20	μA
I _{oz}	Output leakage current; 0V<V _{OUT} <V _{DDQ} ; DQs and ODT are disabled	DQ, DQS, DQS#	-20	20	μA
I _{VREF}	VREF leakage current; VREF = Valid VREF level		-72	72	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	VREF	0.49 x V _{DDQ}	0.50 x V _{DDQ}	0.51 x V _{DDQ}	V	2
I/O Termination voltage	VTT	VREF-0.04	VREF	VREF+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. VREF 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 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. 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	VIH(DC)	VREF + 0.125	VDDQ + 0.300	V
Input Low (Logic 0) Voltage	VIL(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	VIH(AC)	VREF + 0.250	-	V
AC Input High (Logic 1) Voltage DDR2-667	VIH(AC)	VREF + 0.200	-	V
AC Input Low (Logic 0) Voltage DDR2-533 & DDR2-400	VIL(AC)	-	VREF - 0.250	V
AC Input Low (Logic 0) Voltage DDR2-667	VIL(AC)	-	VREF - 0.200	V

Input/Output Capacitance

TA=25°C, f=100MHz

Parameter	Symbol	Min	Max	Unit
Input capacitance (A0 ~ A14, BA0 ~ BA2, RAS#, CAS#, WE#)	CIN1	6.5	7.5	pF
Input capacitance (CKE0, CKE1), (ODT0, ODT1)	CIN2	6.5	7.5	pF
Input capacitance (CS0# ~ CS3#)	CIN3	6.5	7.5	pF
Input capacitance (CK, CK#)	CIN4	6	7	pF
Input/Output capacitance (DQ, DQS, DQS#, DM, CB)	CIN5	14	20	pF



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IDD Specification

IDD Specification						
Condition		Symbol	E6 (DDR2-667)	D5 (DDR2-533)	CC (DDR2-400)	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*	1497	1407	1407	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*	1902	1542	1542	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**	660	660	660	mA
Precharge quiet 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**	1434	1254	1200	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**	1614	1434	1344	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) = 0	IDD3P**	1164	1074	1074	mA
	Slow PDN Exit MRS(12) = 1		732	732	732	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**	1524	1344	1254	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*	2037	1767	1722	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*	2127	1947	1857	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**	5574	5214	5034	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**	360	360	360	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*	3657	3252	3252	mA

Notes: IDD specification is based on Micron A-die components.
*: 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 (DDR2-667)		D5 (DDR2-533)		CC (DDR2-400)		Unit
			Min	Max	Min	Max	Min	Max	
Clock	Clock cycle time	CL=5 $t_{CK}(5)$	3000	8000	-	-	-	-	ps
		CL=4 $t_{CK}(4)$	-	-	3,750	8,000	-	-	ps
		CL=3 $t_{CK}(3)$	-	-	-	-	5,000	8,000	ps
	CK high-level width	$t_{CH(AVG)}$	0.48	0.52	0.48	0.52	0.48	0.52	t_{CK}
	CK low-level width	$t_{CL(AVG)}$	0.48	0.52	0.48	0.52	0.48	0.52	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		ps
	DQ and DM input hold time relative to DQS	t_{DH}	175		225		275		ps
	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_{WPRES}	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')

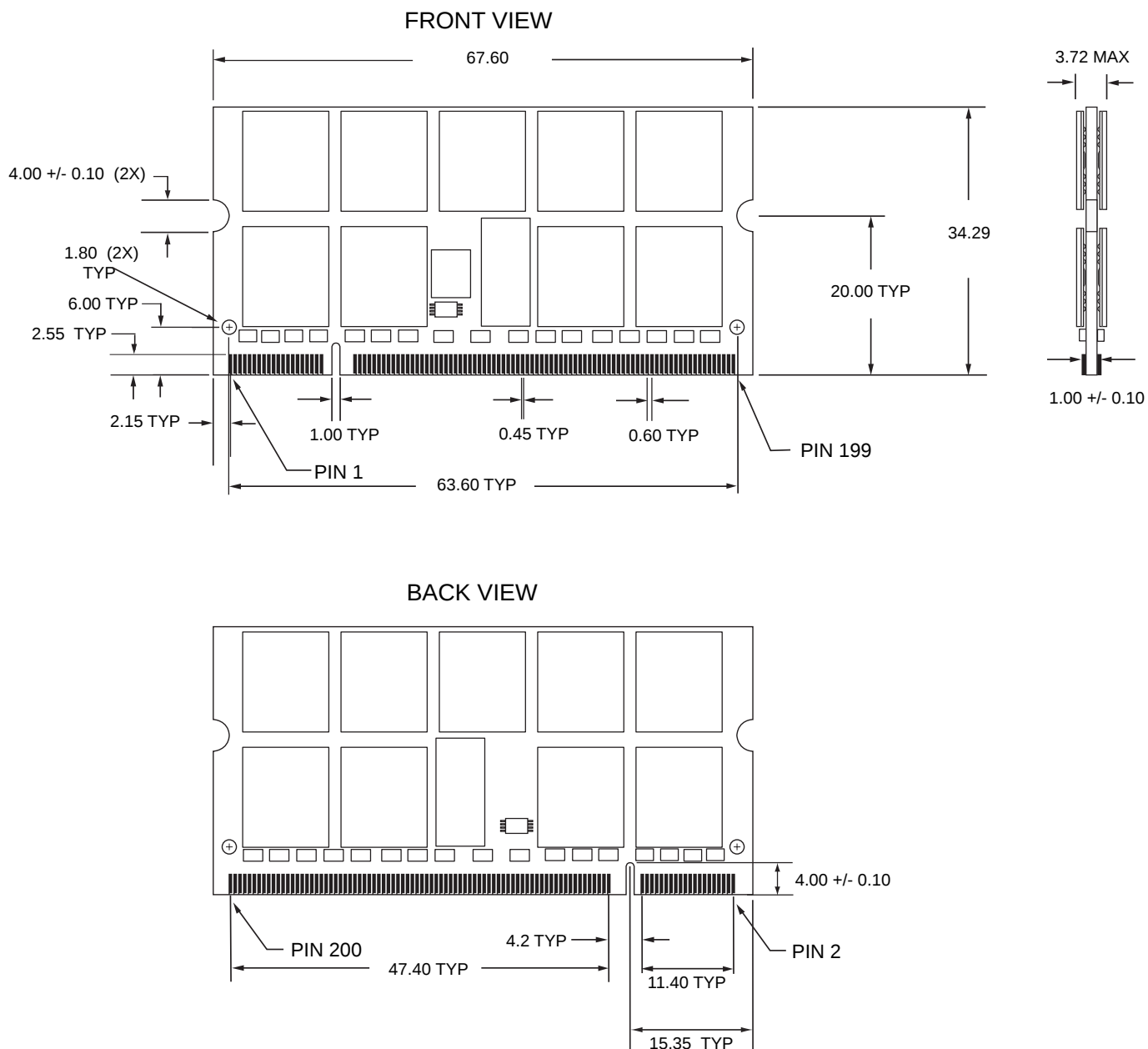
	Parameter	Symbol	E6 (DDR2-667)		D5 (DDR2-533)		CC (DDR2-400)		Unit
			Min	Max	Min	Max	Min	Max	
Command and Address	Address and control input pulse width for each input	t_{PW}	0.6		0.6		0.6		t_{CK}
	Address and control input setup time	t_{IS}	200		250		350		ps
	Address and control input hold time	t_{IH}	275		375		475		ps
	CAS# to CAS# command delay	t_{CCD}	2		2		2		t_{CK}
	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		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}	$t_{WR}+t_{RP}$		$t_{WR}+t_{RP}$		$t_{WR}+t_{RP}$		t_{CK}
	Internal WRITE to READ command delay	t_{WTR}	7.5		7.5		10		ns
	PRECHARGE command period	t_{RP}	15		15		15		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}	197.5	70,000	197.5	70,000	197.5	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	$t_{XS RD}$	200		200		200		t_{CK}
	Exit self refresh timing reference	t_{SXR}	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)	$t_{AOF PD}$	$t_{AC(MIN)}+2000$	$2.5 \times t_{CK} + t_{AC(MAX)}+1000$	$t_{AC(MIN)}+2000$	$2.5 \times t_{CK} + t_{AC(MAX)}+1000$	$t_{AC(MIN)}+2000$	$2.5 \times t_{CK} + t_{AC(MAX)}+1000$	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 +/- 0.15mm unless otherwise specified.



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Revision History

Date	Rev.	Page	Changes
04/08/09	0.01	All	Preliminary spec
09/15/09	0.02	9	Dimension Package update
10/02/09	0.03	1, 3	EEPROM update with thermal sensor
12/02/09	1.0	1, 3, 9	Update to use 2 EEPROMs Spec release
12/20/10	1.1	1	Update General Information