

128M X 72 Bits (1GB) DDR SDRAM 184-Pin 1U Registered DIMM ECC (PC2100)

FEATURES

- PC2100 Compliant
(Option D: DDR266A 133MHz—7.5ns@CL=2)
(Option E: DDR266B 133MHz—7.5ns@CL=2.5)
- 184-Pin DIMM form factor
- Auto and self refresh capability
(8192 cycles/64ms refresh)
- SSTL_2 compatible inputs and outputs
- +2.5V ± 0.2V VDD and VDDQ
- DDR architecture: Two data accesses per clock cycle, differential clock inputs (CK0 and /CK0), and bi-directional data strobe (DQS)
- Four internal banks for concurrent operation
- Auto Precharge option for each burst access
- Burst lengths: 2, 4, 8
- All inputs are sampled at the positive going edge of the system clock; data referenced to both edges of DQS
- Serial Presence Detect with EEPROM
- ECC

GENERAL DESCRIPTION

The SimpleTech SL72E4L128M8M-B75xW is a 128M x 72 bits Double Data Rate (DDR) Synchronous Dynamic RAM (SDRAM) Dual In-line Memory Module (DIMM).

This module consists of thirty-six CMOS 16M x 4 bits x 4 banks DDR SDRAMs in 66-pin 400-mil TSOP-II packages. The DDR SDRAMs are mounted in stacks of two on a 184-pin glass epoxy substrate using the the patented SimpleTech stacking technology.

A serial EEPROM using the two pin IIC protocol is also mounted to provide for the Serial Presence Detects (SPD). PLL circuits supply clocks to the DDR SDRAMs. Decoupling capacitors of 0.22µF are also mounted. Damping resistors are added to the DQ, DM, and DQS signals.

All control and address signals are re-driven through a register to the SDRAM devices. The control/address input signals are latched in the register on one rising clock edge and sent to the SDRAM devices on the following rising clock edge (data access is delayed by one clock).

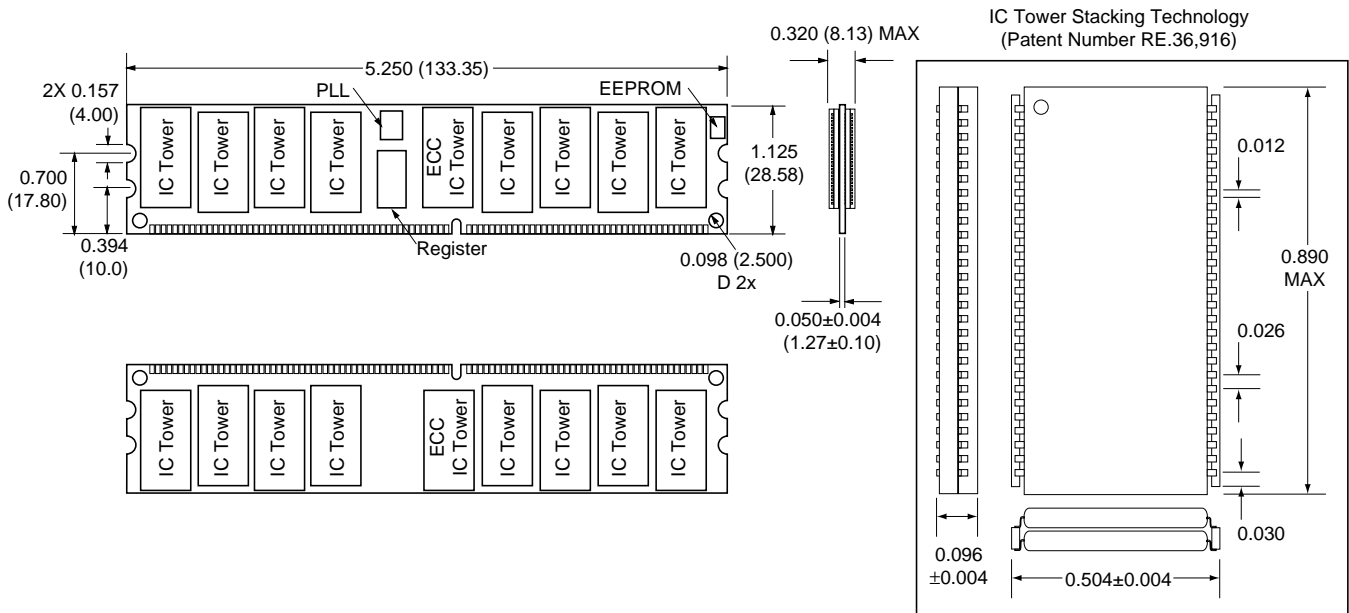
The module has gold edge connections and is intended for mounting into 184-pin DIMM edge connector sockets keyed for 2.5V VDD and VDDQ.

ORDERING INFORMATION

Part Number	CL	MHz
SL72E4L128M8M-B75DW	2	133
SL72E4L128M8M-B75EW	2.5	133

PACKAGE DIMENSIONS

Units are in inches (millimeters). Tolerances are ±0.005 (±0.127) unless otherwise specified.



PIN CONFIGURATION (*=Not Used; /=Active Low)

Pinout

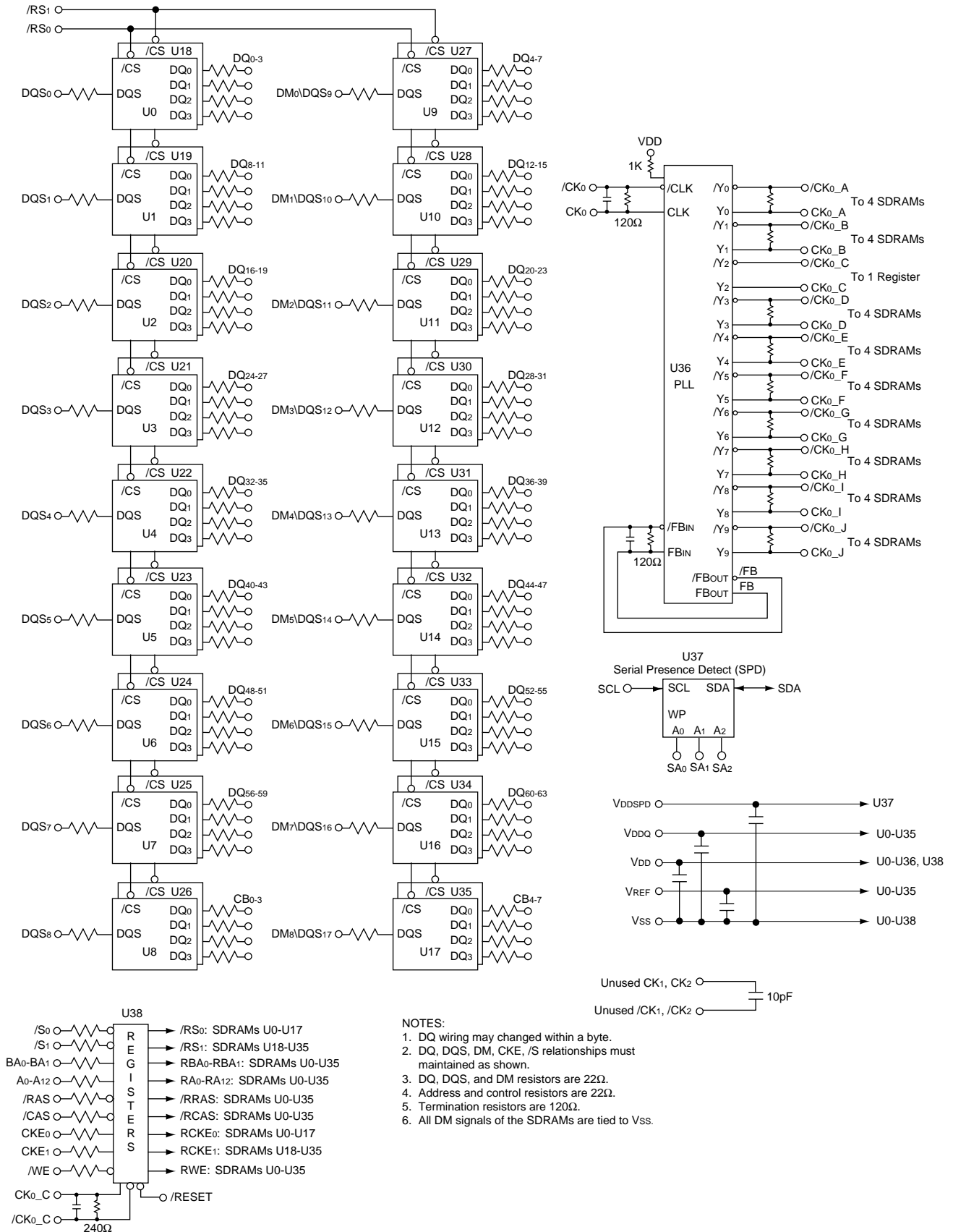
Pin	Front	Pin	Back	Pin	Front	Pin	Back	Pin	Front	Pin	Back
1	VREF	93	VSS	32	A5	124	VSS	62	VDDQ	154	/RAS
2	DQ0	94	DQ4	33	DQ24	125	A6	63	/WE	155	DQ45
3	VSS	95	DQ5	34	VSS	126	DQ28	64	DQ41	156	VDDQ
4	DQ1	96	VDDQ	35	DQ25	127	DQ29	65	/CAS	157	/S0
5	DQS0	97	DM0\DQS9	36	DQS3	128	VDDQ	66	VSS	158	/S1
6	DQ2	98	DQ6	37	A4	129	DM3\DQS12	67	DQS5	159	DM5\DQS14
7	VDD	99	DQ7	38	VDD	130	A3	68	DQ42	160	VSS
8	DQ3	100	VSS	39	DQ26	131	DQ30	69	DQ43	161	DQ46
9	NC	101	NC	40	DQ27	132	VSS	70	VDD	162	DQ47
10	/RESET	102	NC	41	A2	133	DQ31	71	/S2*	163	/S3*
11	VSS	103	A13*	42	VSS	134	CB4	72	DQ48	164	VDDQ
12	DQ8	104	VDDQ	43	A1	135	CB5	73	DQ49	165	DQ52
13	DQ9	105	DQ12	44	CB0	136	VDDQ	74	VSS	166	DQS3
14	DQS1	106	DQ13	45	CB1	137	CK0	75	CK2*	167	FETEN*
15	VDDQ	107	DM1\DQS10	46	VDD	138	/CK0	76	/CK2*	168	VDD
16	CK1*	108	VDD	47	DQS8	139	VSS	77	VDDQ	169	DM6\DQS15
17	/CK1*	109	DQ14	48	A0	140	DM8\DQS17	78	DQS6	170	DQ54
18	VSS	110	DQ15	49	CB2	141	A10	79	DQ50	171	DQ55
19	DQ10	111	CKE1	50	VSS	142	CB6	80	DQ51	172	VDDQ
20	DQ11	112	VDDQ	51	CB3	143	VDDQ	81	VSS	173	NC
21	CKE0	113	BA2*	52	BA1	144	CB7	82	VDDID*	174	DQ60
22	VDDQ	114	DQ20		Key		Key	83	DQ56	175	DQ61
23	DQ16	115	A12	53	DQ32	145	VSS	84	DQ57	176	VSS
24	DQ17	116	VSS	54	VDDQ	146	DQ36	85	VDD	177	DM7\DQS16
25	DQS2	117	DQ21	55	DQ33	147	DQ37	86	DQS7	178	DQ62
26	VSS	118	A11	56	DQS4	148	VDD	87	DQ58	179	DQ63
27	A9	119	DM2\DQS11	57	DQ34	149	DM4\DQS13	88	DQ59	180	VDDQ
28	DQ18	120	VDD	58	VSS	150	DQ38	89	VSS	181	SA0
29	A7	121	DQ22	59	BA0	151	DQ39	90	NC	182	SA1
30	VDDQ	122	A8	60	DQ35	152	VSS	91	SDA	183	SA2
31	DQ19	123	DQ23	61	DQ40	153	DQ44	92	SCL	184	VDDSPD

Pin Description

Pin Symbol	Pin Description
A0-A11, A12, A13*	SDRAM address bus
BA0-BA1, BA2*	SDRAM bank select
DQ0-DQ63	DIMM memory data bus
CB0-CB7	DIMM ECC check bits
/RAS	SDRAM row address strobe
/CAS	SDRAM column address strobe
/WE	SDRAM write strobe
/S0, /S1, /S2*, /S3*	SDRAM chip select lines (Physical banks 0, 1, 2, and 3)
CKE0, CKE1	SDRAM clock enable lines
DQS0-DQS8	SDRAM low data strobes
DM(0-8)\DQS(9-17)	SDRAM low data masks/high data strobes (x4, x8-based x72 DIMMS)
VDDID*	VDD Identification flag
CK0, CK1*, CK2*	SDRAM clock (positive line of differential pair)

Pin Symbol	Pin Description
/CK0, /CK1*, /CK2*	SDRAM clock (negative line of differential pair)
SCL	IIC serial bus clock for EEPROM
SDA	IIC serial bus data line for EEPROM
SA0-SA2	IIC slave address select for EEPROM
VDD	SDRAM positive power supply
VDDQ	SDRAM I/O driver positive power supply
VREF	SDRAM I/O reference supply
VSS	Power supply return (ground)
VDDSPD	Serial EEPROM positive power supply (2.5 volts)
NC	Spare pins (no connect)
/RESET	Reset pin (forces register inputs low)
FETEN*	FET enable line

FUNCTIONAL BLOCK DIAGRAM



SERIAL PRESENCE DETECT INFORMATION

Serial PD Interface Protocol: IIC; Current sink capability of SDA driver $\leq 3\text{mA}$; Maximum clock frequency: 100 KHz

Byte #	Function Described	Function Supported		Hex Value	
		DDR266A	DDR266B	DDR266A	DDR266B
0	# of bytes written into serial memory at module manufacturer	128 bytes		80h	
1	Total # of bytes of SPD memory device	256Bytes (2K-bit)		08h	
2	Fundamental memory type	DDR SDRAM		07h	
3	# of row addresses on this assembly	13		0Dh	
4	# of column addresses on this assembly	11		0Bh	
5	# of physical banks on this assembly	2 banks		02h	
6	Data width of this assembly	72 bits		48h	
7	...Data width of this assembly (continued)	—		00h	
8	Voltage interface level of this assembly	SSTL 2.5V		04h	
9	SDRAM cycle time at CL=2.5 (tCYC)	7.5ns	7.5ns	75h	75h
10	SDRAM access time from clock at CL=2.5 (tAC)	0.75ns	0.75ns	75h	75h
11	DIMM configuration type	ECC		02h	
12	Refresh rate/type	7.8 μ s, Self -refresh		82h	
13	SDRAM width	4 bits		04h	
14	Error Checking SDRAM data width	4 bits		04h	
15	Min. CLK delay for back-to-back rand. col. addr.	tCCD=1 CLK		01h	
16	SDRAM device attributes: burst lengths supported	2,4,8		0Eh	
17	SDRAM device attributes: # of banks on SDRAM device	4 banks		04h	
18	SDRAM device attributes: CAS latency	CAS latency = 2.0, 2.5		0Ch	
19	SDRAM device attributes: CS latency	CS latency = 0		01h	
20	SDRAM device attributes: Write latency	Write Latency = 1		02h	
21	SDRAM module attributes	Registered with Differential clock, PLL		26h	
22	SDRAM device attributes: general	V _{DD} ±0.2V		00h	
23	Minimum clock cycle time at CL=2 (tCYC)	7.5ns	10ns	75h	A0h
24	Max. data access time form clock at CL=2 (tAC)	0.75ns	0.75ns	75h	75h
25	Minimum clock cycle time at CL=1.5 (tCYC)	N/A		00h	
26	Max. data access time from clock at CL=1.5 (tAC)	N/A		00h	
27	Minimum row precharge time (tRP)	20.0ns		50h	
28	Minimum row active to row active delay (tRRD)	15.0ns		3Ch	
29	Minumum RAS to CAS (tRCD)	20.0ns		50h	
30	Minumum RAS pulse width (tRAS)	45ns		2Dh	
31	Module bank density	512MB		80h	
32	Min. command and address signal setup time (tIS)	0.9ns		90h	
33	Min. command and address signal hold time (tIH)	0.9ns		90h	
34	Min. data/data mask signal input setup time (tDS)	0.5ns		50h	
35	Min. data/data mask signal input hold time (tDH)	0.5ns		50h	

continued on the next page

SERIAL PRESENCE DETECT INFORMATION (continued)

Byte #	Function Described	Function Supported		Hex Value	
		DDR266A	DDR266B	DDR266A	DDR266B
41	Row cycle time (tRC)	65ns		41h	
42	Auto refresh cycle time (tRFC)	75ns		4Bh	
43	Maximum SDRAM device cycle time (tCK_MAX)	12ns		30h	
44	DQS-DQ skew (tDQSQ)	0.50ns		32h	
45	SDRAM device data hold skew factor (tQHS)	0.75ns		75h	
46-61	Reserved			00h	
62	SPD revision	JEDEC 1		00h	
63	Checksum for bytes 0-62	JEDEC calculation		xxh	
64	Manufacturer's JEDEC ID code per JEP-106E	Continuation code		7Fh	
65	Man. JEDEC ID code (continued)	SimpleTech's ID		A8h	
66-71				00h	
72	Manufacturing location	SimpleTech USA		01h	
73-90	Manufacturer's part number			xxh	
91	Revision code of PCB	Eng(00),RevA(01),RevB(02)		01h	
92				00h	
93	Manufacturing date	Year (BCD)		yy	
94		Calender Week (BCD)		ww	
95	Assembly serial number	Tester number		ss	
96		Serial number (bits 7-0)		ss	
97		Serial number (bits 15-8)		ss	
98		Serial number (bits 23-16)		ss	
99-127	Manufacturer's specific data			xxh	
128-255	Open for Customer Use	Undefined		FFh	

ABSOLUTE MAXIMUM RATINGS*

Parameter	Symbol	Value	Unit
Voltage on any pin relative to V _{SS}	V _{IN} , V _{OUT}	-0.5 to +3.6	V
Voltage on V _{DD} supply relative to V _{SS}	V _{DD}	-1.0 to +3.6	V
Voltage on V _{DDQ} supply relative to V _{SS}	V _{DDQ}	-1.0 to +3.6	V
Storage temperature	T _{STG}	-55 to +150	°C
Power Dissipation	P _D	54	W
Short circuit current	I _{OS}	50	mA

* Permanent device damage may occur if ABSOLUTE MAXIMUM RATINGS are exceeded. Functional Operation should be restricted to recommended operating condition. Exposure to higher than recommended voltage for extended periods of time may affect device reliability.

POWER and DC Operating Conditions (SSTL_2 In/Out)

Recommended operating conditions (Voltage referenced to V_{SS}=0V. T_A=0 to 70°C)

Parameter	Symbol	Min	Max	Unit	Notes
Supply Voltage (for device with a nominal V _{DD} of 2.5V)	V _{DD}	2.3	2.7	V	
I/O Supply voltage	V _{DDQ}	2.3	2.7	V	
I/O Reference voltage	V _{REF}	V _{DDQ} /2-50mV	V _{DDQ} /2+50mV	V	1
I/O Termination voltage (system)	V _{TT}	V _{REF} -0.04	V _{REF} +0.04	V	2
Input logic high voltage	V _{IH} (DC)	V _{REF} +0.15	V _{DDQ} +0.3	V	
Input logic low voltage	V _{IL} (DC)	-0.3	V _{REF} -0.15	V	
Input voltage level, CK and /CK	V _{IN} (DC)	-0.3	V _{DDQ} +0.3	V	
Input differential voltage, CK and /CK	V _{ID} (DC)	0.3	V _{DDQ} +0.6	V	3
Input leakage current	I _L	-5	5	μA	
Output leakage current	I _{OZ}	-10	10	μA	
Output high current (V _{OUT} =V _{TT} +0.48V)	I _{OH}	-16.8		mA	
Output low current (V _{OUT} =V _{TT} -0.48V)	I _{OL}	16.8		mA	

1. V_{REF} is expected to be equal to 0.5*V_{DDQ} 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 2% of the DC value.
2. 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}.
3. V_{ID} is the magnitude of the difference between the input level on CK and the input level on /CK.

DC CHARACTERISTICS

(Recommended operating conditions unless otherwise noted)

Conditions	Symbol	Max	Unit
<i>Operating Current—One bank Active-Precharge</i> tRC=tRCmin; tCK=100MHz for DDR200, 133MHz for DDR266A and DDR266B; DQ, DM, and DQS inputs changing twice per clock cycle; address and control inputs changing once per clock cycle.	IDD0	2290	mA
<i>Operating Current—One bank operation;</i> One bank open, BL=4, Reads, Refer to the following page for detailed test condition.	IDD1	2650	mA
<i>Precharge Power-Down Standby Current;</i> All banks idle; power-down mode; CKE=<VIL(max); tCK=100MHz for DDR200, 133MHz for DDR266A and DDR266B; Vin=Vref for DQ, DQS, and DM.	IDD2P	148	mA
<i>Precharge Floating Standby Current;</i> /CS>=VIH(min); all banks idle; CKE>=VIL(min); tCK=100MHz for DDR200, 133MHz for DDR266A and DDR266B; address and other control inputs changing once per clock cycle; Vin=Vref for DQ, DQS, and DM.	IDD2F	760	mA
<i>Precharge Quiet Standby Current;</i> /CS VIH(min); all banks idle; CKE ≥VIH(min); tCK=100MHz for DDR200, 133MHz for DDR266A and DDR266B; address and other control inputs stable with keeping ≥VIH(min) or =<VIL(max); Vin=Vref for DQ, DQS, and DM.	IDD2Q	688	mA
<i>Active Power-Down Standby Current;</i> One bank active; power-down mode; CKE=<VIL(max); tCK=100MHz for DDR200, 133MHz for DDR266A and DDR266B; Vin=Vref for DQ, DQS, and DM.	IDD3P	1120	mA
<i>Active Standby Current;</i> /CS>=VIH(min); CKE>=VIH(min); one bank active; active-precharge; tRC=tRAS(max); tCK=100MHz for DDR200, 133MHz for DDR266A and DDR266B; DQ, DQS, and DM inputs changing twice per clock cycle; address and control inputs changing once per clock cycle.	IDD3N	1660	mA
<i>Operating Current—Burst Read;</i> Burst length=2; reads; continuous burst; one bank active; address and control inputs changing once per clock cycle; CL=2 at tCK=100MHz for DDR200, CL=2 at tCK=133MHz for DDR266A, CL=2.5 at tCK=133MHz for DDR266B; 50% of data changing at every burst; Iout=0mA	IDD4R	2200	mA
<i>Operating Current—Burst Write;</i> Burst length=2; writes; continuous burst; one bank active; address and control inputs changing once per clock cycle; CL=2 at tCK=100MHz for DDR200, CL=2 at tCK=133MHz for DDR266A, CL=2.5 at tCK=133MHz for DDR266B; DQ, DQS, and DM inputs changing twice per clock cycle, 50% of input data changing at every burst.	IDD4W	3280	mA
<i>Auto Refresh Current;</i> tRC=tRFC(min) - 8*tCK for DDR200 at 100MHz, 10*tCK for DDR266A and DDR266B at 133MHz; distributed refresh.	IDD5	3820	mA
<i>Self Refresh Current;</i> CKE=0.2V; External clock should be on; tCK=100MHz for DDR200, 133MHz for DDR266A and DDR266B.	IDD6	108	mA
<i>Operating Current—Four Bank Operation;</i> Four bank interleaving with BL=4. Refer to the following page for detailed test condition.	IDD7	5350	mA

Typical case: VDD=2.5V, T=25°C; Worst case: VDD=2.7, T=10°C

Module IDD was calculated on the basis of component IDD and can be differently measured according to DQ loading cap.

Detailed Test Conditions for DDR SDRAM IDD1

(A=Activate, R=Read, W=Write, P=Precharge, N=NOP)

1. Typical Case: VDD=2.5V, T=25°C.
2. Worst Case: VDD=2.7V, T=10°C.
3. Only one bank is accessed with tRC(min), Burst Mode, Address and Control inputs on NOP edge are changing once per clock cycle. I_{out}=0mA.
4. Timing patterns:
 - DDR200 (100MHz, CL=2): tCK=10ns, CL=2, BL=4, tRCD=2*tCK, tRAS=5*tCK
Read: A0 N R0 N N P0 N A0 N —repeat the same timing with random address changing
50% of data changing at every burst.
 - DDR266B (133MHz, CL=2.5): tCK=7.5ns, CL=2.5, BL=4, tRCD=3*tCK, tRC=9*tCK, tRAS=5*tCK,
Read: A0 N N R0 N P0 N N N A0 N —repeat the same timing with random address changing,
50% of data changing at every burst.
 - DDR266A (133MHz, CL=2): tCK=7.5ns, CL=2, BL=4, tRCD=3*tCK, tRC=9*tCK, tRAS=5*tCK,
Read: A0 N N R0 N P0 N N N A0 N —repeat the same timing with random address changing,
50% of data changing at every burst.

Detailed Test Conditions for DDR SDRAM IDD7

(A=Activate, R=Read, W=Write, P=Precharge, N=NOP)

1. Typical Case: VDD=2.5V, T=25°C.
2. Worst Case: VDD=2.7V, T=10°C.
3. Four banks are being interleaved with tRC(min), Burst Mode, Address and Control inputs on NOP edge are not changing. I_{out}=0mA.
4. Timing patterns:
 - DDR200 (100MHz, CL=2): tCK=10ns, CL=2, BL=4, tRRD=2*tCK, tRCD=3*tC, Read with autoprecharge
Read: A0 N A1 R0 A2 R1 A3 R2 A0 R3 A1 R0 — repeat the same timing with random address changing
100% of data changing at every burst.
 - DDR266B (133MHz, CL=2.5): tCK=7.5ns, CL=2.5, BL=4, tRRD=2*tCK, tRCD=3*tCK, Read with autoprecharge,
Read: A0 N A1 R0 A2 R1 A3 R2 N R3 A0 N A1 R0 — repeat the same timing with random address changing,
100% of data changing at every burst.
 - DDR266A (133MHz, CL=2): tCK=7.5ns, CL=2, BL=4, tRRD=3*tCK, tRCD=3*tCK,
Read: A0 N A1 R0 A2 R1 A3 R2 N R3 A0 N A1 R0 — repeat the same timing with random address changing,
100% of data changing at every burst.

AC Operating Conditions

(VDD=VDDQ=2.5V, TA=25°C, f=1MHz)

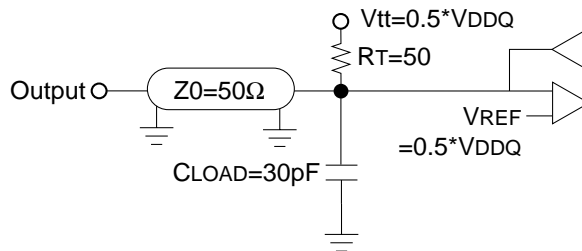
Parameter/Condition	Symbol	Min	Max	Units	Note
Input High (Logic 1) Voltage, DQ, DQS, and DM signals	V _{IH} (AC)	VREF+0.31		V	1
Input Low (Logic 0) Voltage, DQ, DQS, and DM signals	V _{IL} (AC)		VREF-0.31	V	2
Input Differential Voltage, CK and /CK inputs	V _{ID} (AC)	0.7	VDDQ+0.6	V	3
Input Crossing Point Voltage, CK and /CK inputs	V _{IX} (AC)	0.5*VDDQ-0.2	0.5*VDDQ+0.2	V	4

1. V_{IH}(max)=4.2V. The overshoot voltage duration is ≤3ns at VDD.
2. V_{IL}(min)=-1.5V. The undershoot voltage duration is ≤3ns at VSS.
3. V_{ID} is the magnitude of the difference between the input level on CK and the input on /CK.
4. The value of V_{IX} is expected to equal 0.5*VDDQ of the transmitting device and must track variations in the DC level of the same.

AC OPERATING TEST CONDITIONS

($V_{DD}=V_{DDQ}=2.5V$, $T_A=0^{\circ}C$ to $70^{\circ}C$)

Parameter	Value	Unit
Input reference voltage for Clock	$0.5 \cdot V_{DDQ}$	V
Input signal maximum peak swing	1.5	V
Input signal minimum slew rate	0.5	V/ns
Input levels (V_{IH}/V_{IL})	$V_{REF}+0.31/V_{REF}-0.31$	V
Input timing measurement ref. level	V_{REF}	V
Output timing measurement ref. level	V_{TT}	V
Output load condition	See Load Circuit	



Output Load Circuit (SSTL_2)

Input/Output CAPACITANCE

($V_{DD}=V_{DDQ}=2.5V$, $T_A=25^{\circ}C$, $f=1MHz$)

Parameter	Symbol	Max	Units
Input Capacitance (A_0-A_{12} , BA_0 , BA_1 , $/RAS$, $/CAS$, $/WE$)	C_{IN1}	15	pF
Input Capacitance (CKE_0 , CKE_1)	C_{IN2}	15	pF
Input Capacitance ($/S_0$, $/S_1$)	C_{IN3}	15	pF
Input Capacitance (CK_0)	C_{IN4}	9	pF
Input Capacitance ($DM_0/DQS_9-DM_8/DQS_{17}$, DQS_0-DQS_8)	C_{IN5}	20	pF
Data Input/Output Capacitance (DQ_0-DQ_{63})	C_{OUT1}	20	pF
Data Input/Output Capacitance (CB_0-CB_7)	C_{OUT2}	20	pF

AC TIMING PARAMETERS (These AC characteristics were tested on the Component)

Symbol	Parameter	Speed Grade DDR266A/B		Unit	Notes
		Min	Max		
tRC	Row cycle time	65		ns	
tRFC	Refresh row cycle time	75		ns	
tRAS	Row active time	45	120K	ns	
tRCD	/RAS to /CAS delay	20		ns	
tRP	Row precharge time	20		ns	
tRRD	Row active to Row active delay	15		ns	
tWR	Write recovery time	15		ns	
tCDLR	Last data in to Read command	1		tCK	
tCCD	Col. address to Col. address delay	1		tCK	
tCK	Clock cycle time	CL=2.0	7.5/10*	12	ns
	Clock cycle time	CL=2.5	7.5	12	ns
tCH	Clock high level width	0.45	0.55	tCK	
tCL	Clock low level width	0.45	0.55	tCK	
tDQSCK	DQS-out access time from CK, /CK	-0.75	+0.75	ns	
tAC	Output data access time from CK, /CK	-0.75	+0.75	ns	
tDQSQ	Data strobe edge to output data edge		+0.5	ns	
tRPRE	Read Preamble	0.9	1.1	tCK	
tRPST	Read Postamble	0.4	0.6	tCK	
tDQSS	CK to valid DQS-in	0.75	1.25	tCK	
tWPRES	DQS-in setup time	0		ns	3
tWPRE	DQS-in hold time	0.25		tCK	
tDQSH	DQS-in high level width	0.35		tCK	
tDQSL	DQS-in low level width	0.35		tCK	
tDSC	DQS-in cycle time	0.9	1.1	tCK	
tIS	Address and Control Input setup time	0.9		ns	
tIH	Address and Control Input hold time	0.9		ns	
tMRD	Mode register set cycle time	15		ns	
tDS	DQ and DM setup time to DQS	0.5		ns	
tDH	DQ and DM hold time to DQS	0.5		ns	
tDIPW	DQ and DM input pulse width	1.75		ns	
tPDEX	Power down exit time10	7.5		ns	
tXSNR	Exit self refresh to non-read command	75		ns	
tXSRD	Exit self refresh to read command	200		tCK	
tREF	Refresh interval time	7.8		μs	1
tQH	Output DQS valid window	tHPmin -0.75		ns	
tHP	Clock half period	tCLmin or tCHmin		ns	
tWPST	DQS write postamble time	0.4	0.6	tCK	4
tDAL	Auto precharge write recovery +Precharge time	(tWR/tCK) + (tRP/tCK)		tCK	

* This value depends on the DDR option. The first value is for DDR266A (option D), and the second value is for DDR266B (option E). See Ordering Information.

Notes

1. Maximum burst refresh of 8.
2. tHZQ transitions occurs in the same access time windows as valid data transitions. These parameters are not referenced to a specif voltage level, but specify when the device output is no longer driving.
3. The specific requirement is that DQS be valid (high or low) on or before this CK edge. The case shown (DQS going from High_Z to logic Low) applies when no writes were previously in progress on the bus. If a previous write was in progress, DQS could be High at this time, depending on tDQSS.
4. The maximum limit for this parameter is not a device limit. The device will operate with a great value for this parameter, but system performance (bus turnaround) will degrade accordingly.
5. The value of tQCSW min. is 1.25ns from the last low going data strobe edge to /QFC high. And the value of tQCSW max. is 0.5tCK from the first high going clock edge after the last low going data strobe edge to /QFC high.
6. The value of tQCSWI max. is 1.5tCK from the first high going clock edge after the last low going data strobe edge to /QFC high.
7. A write command can be applied with tRCD satisfied after this command.

REVISION HISTORY

Rev. Change Description from Previous Revision

- 101 Initial release.
- 102 Option D (DDR266A) is added. 4/2/02.