

## 32M X 72 Bit (256MB) 144-Pin SDRAM SO-DIMM with ECC (PC100)

### FEATURES

- PC100 Compliant  
(see *Ordering Information* for options)
- Burst Mode Operation
- Auto and self refresh capability  
(8192 cycles/64ms refresh)
- LVTTTL compatible inputs and outputs
- +3.3V  $\pm$  0.3V power supply
- MRS cycle with address key programs
  - Latency (access from column address)
  - Burst Length (1, 2, 4, 8)
  - Data scramble (sequential and interleave)
- All inputs are sampled at the positive going edge of the system clock
- Serial Presence Detect with EEPROM
- ECC
- RoHS Compliant, lead-free

### GENERAL DESCRIPTION

The SL72G8F32M8H-A10xVU is a 32M x 72 bit Synchronous Dynamic RAM (SDRAM) Small-Outline Dual In-line Memory Module (SO-DIMM).

The module consists of nine CMOS 8M x 8 bit x 4 bank SDRAMs in 54-pin 400-mil TSOP II packages mounted on a 144-pin glass epoxy substrate.

A serial EEPROM using the two pin I<sup>2</sup>C protocol is also mounted to provide for the Serial Presence Detects (SPD). Decoupling capacitors of 0.1 $\mu$ F are mounted. Damping resistors are mounted for the data lines. A PLL supplies clocks to the SDRAMs from one clock input.

The module has gold edge connections and is intended for mounting into 144-pin SO-DIMM edge connector sockets keyed for 3.3V.

See *Ordering Information* for PC100 performance options.

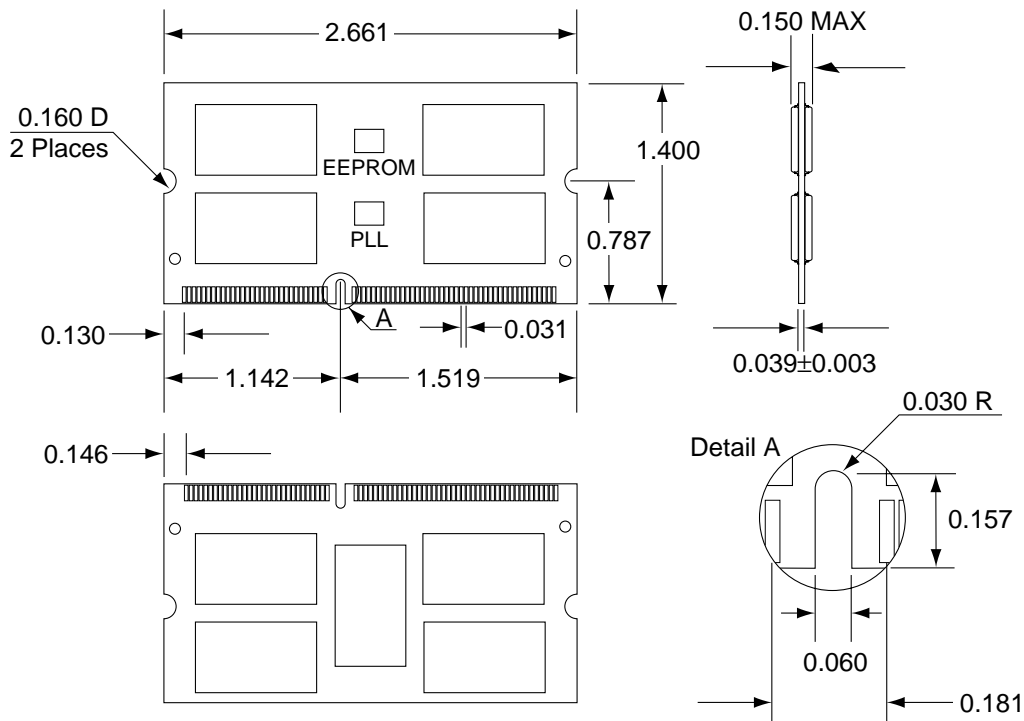
### ORDERING INFORMATION

Part Number	PC100 100MHz Parameters					Units	Comment
	CL	tRCD	tRP	tRC			
SL72G8F32M8H-A10CVU	3	2	2	7		clks	Option "C"
SL72G8F32M8H-A10DVU	2	2	2	7		clks	Option "D"

**Note:** The "U" suffix added to the part number selects the RoHS Compliant, lead-free version.

### PACKAGE DIMENSIONS

Units are in inches. Tolerances are  $\pm$ 0.005 unless otherwise specified.

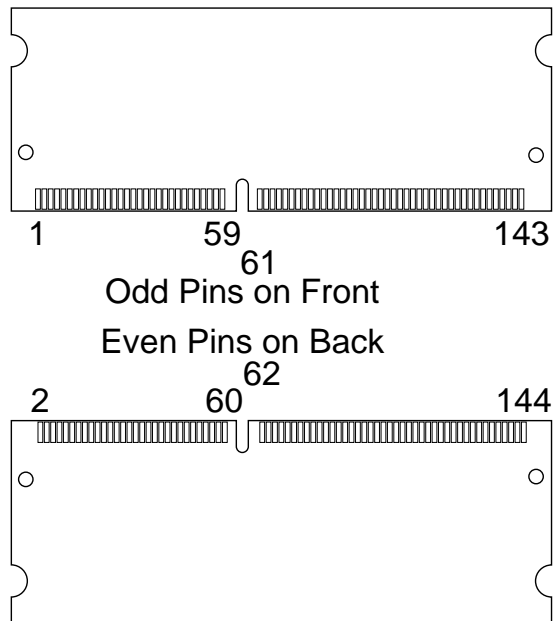


**PIN CONFIGURATION**

Pin Symbols (\* = Not Used)

Pin	Symbol	Pin	Symbol	Pin	Symbol	Pin	Symbol	Pin	Symbol	Pin	Symbol	Pin	Symbol	Pin	Symbol
1	VSS	21	VSS	41	DQ10	61	CLK0	81	VDD	101	VDD	121	DQ24	141	SDA
2	VSS	22	VSS	42	DQ42	62	CKE0	82	VDD	102	VDD	122	DQ56	142	SCL
3	DQ0	23	DQMB0	43	DQ11	63	VDD	83	DQ16	103	A6	123	DQ25	143	VDD
4	DQ32	24	DQMB4	44	DQ43	64	VDD	84	DQ48	104	A7	124	DQ57	144	VDD
5	DQ1	25	DQMB1	45	VDD	65	$\overline{\text{RAS}}$	85	DQ17	105	A8	125	DQ26		
6	DQ33	26	DQMB5	46	VDD	66	$\overline{\text{CAS}}$	86	DQ49	106	BA0	126	DQ58		
7	DQ2	27	VDD	47	DQ12	67	$\overline{\text{WE}}$	87	DQ18	107	VSS	127	DQ27		
8	DQ34	28	VDD	48	DQ44	68	CKE1*	88	DQ50	108	VSS	128	DQ59		
9	DQ3	29	A0	49	DQ13	69	$\overline{\text{S}}_0$	89	DQ19	109	A9	129	VDD		
10	DQ35	30	A3	50	DQ45	70	A12	90	DQ51	110	BA1	130	VDD		
11	VDD	31	A1	51	DQ14	71	$\overline{\text{S}}_1^*$	91	VSS	111	A10/AP	131	DQ28		
12	VDD	32	A4	52	DQ46	72	A13*	92	VSS	112	A11	132	DQ60		
13	DQ4	33	A2	53	DQ15	73	NC	93	DQ20	113	VDD	133	DQ29		
14	DQ36	34	A5	54	DQ47	74	CLK1*	94	DQ52	114	VDD	134	DQ61		
15	DQ5	35	VSS	55	VSS	75	VSS	95	DQ21	115	DQMB2	135	DQ30		
16	DQ37	36	VSS	56	VSS	76	VSS	96	DQ53	116	DQMB6	136	DQ62		
17	DQ6	37	DQ8	57	CB0	77	CB2	97	DQ22	117	DQMB3	137	DQ31		
18	DQ38	38	DQ40	58	CB4	78	CB6	98	DQ54	118	DQMB7	138	DQ63		
19	DQ7	39	DQ9	59	CB1	79	CB3	99	DQ23	119	VSS	139	VSS		
20	DQ39	40	DQ41	60	CB5	80	CB7	100	DQ55	120	VSS	140	VSS		

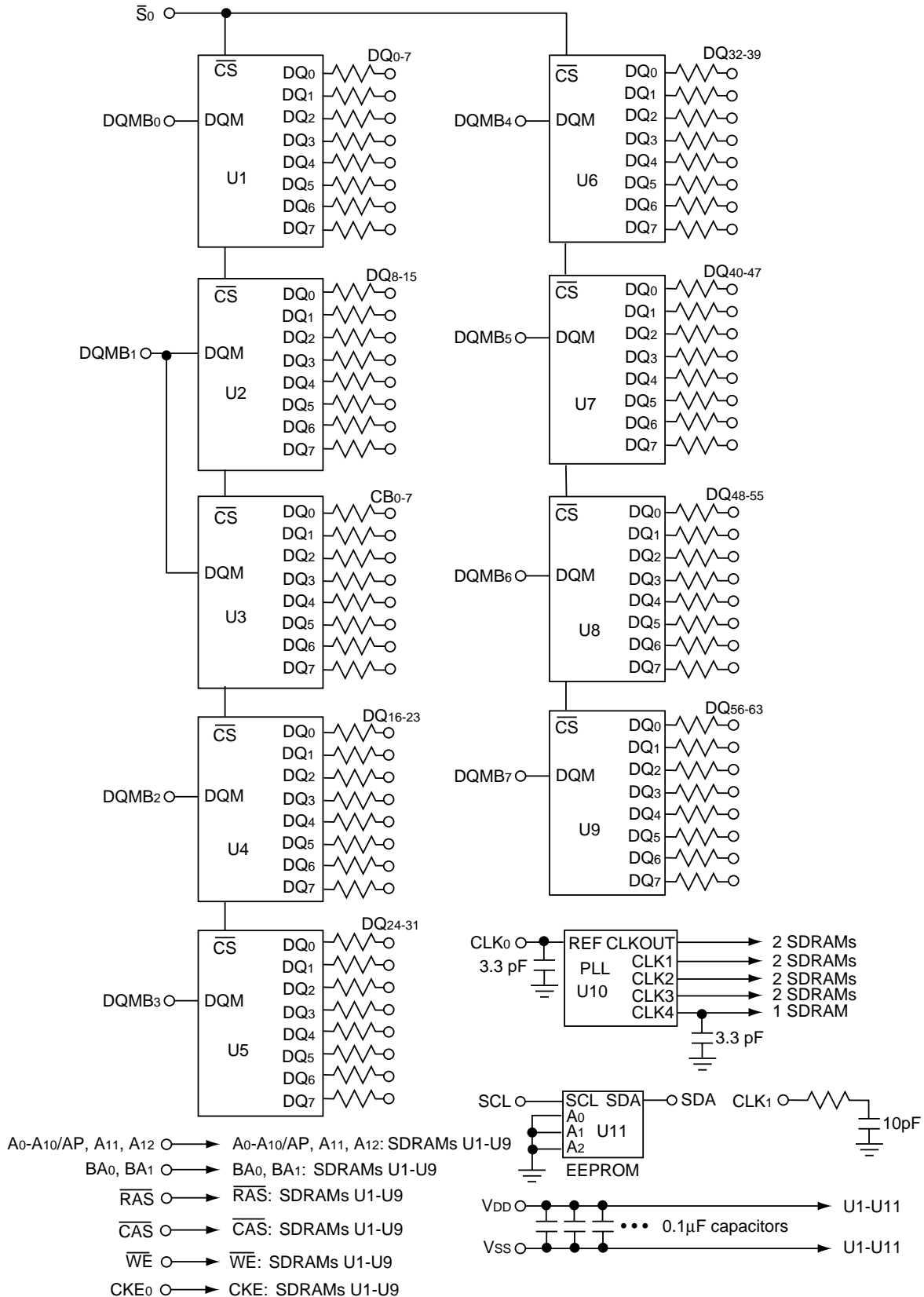
**Pin Arrangement**



**Pin Functions**

Pin Name	Pin Function
A0-A10/AP, A11, A12	Address Inputs (multiplexed)
BA0, BA1	Select Bank
DQ0-DQ63	Data In/Out
CB0-CB7	Check Bits
$\overline{\text{WE}}$	Read/Write Enable
CLK0	Clock Input
CKE0	Clock Enable Input
$\overline{\text{RAS}}$	Row Address Strobe
$\overline{\text{CAS}}$	Column Address Strobe
DQMB0-DQMB7	Data Input/Output Mask
$\overline{\text{S}}_0$	Chip Select Input
SDA	Serial Data I/O
SCL	Serial Clock
VDD	Power (+3.3V)
VSS	Ground
NC	No Connection

FUNCTIONAL BLOCK DIAGRAM



## SERIAL PRESENCE DETECT INFORMATION

Serial PD Interface Protocol: I<sup>2</sup>C; Current sink capability of SDA driver <=3mA; Maximum clock frequency: 100 KHz

Byte #	Function Described	Function Supported		Hex Value	
		C	D	C	D
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	SDRAM		04h	
3	# of row addresses on this assembly	13		0Dh	
4	# of column addresses on this assembly	10		0Ah	
5	# of module banks on this assembly	1 bank		01h	
6	Data width of this assembly	72 bits		48h	
7	...Data width of this assembly (continued)	—		00h	
8	Voltage interface standard of this assembly	LVTTTL		01h	
9	SDRAM cycle time at CL=3 (tCYC)	10ns	10ns	A0h	A0h
10	SDRAM access time from clock at CL=3 (tAC)	6ns	6ns	60h	60h
11	DIMM configuration type	ECC		02h	
12	Refresh rate/type	7.8µs, Self-refresh		82h	
13	SDRAM width	8 bits		08h	
14	Error Checking DRAM data width	8 bits		08h	
15	Min. CLK delay for back-to-back rand. col. addr.	tCCD=1 CLK		01h	
16	SDRAM device attributes: burst lengths supported	1,2,4,8		0Fh	
17	SDRAM device attributes: # of banks on SDRAM device	4 banks		04h	
18	SDRAM device attributes: CAS latency	CAS latency = 2,3		06h	
19	SDRAM device attributes: CS latency	CS latency = 0		01h	
20	SDRAM device attributes: Write latency	Write Latency = 0		01h	
21	SDRAM module attributes	on-card PLL, non-buff., non-reg.		04h	
22	SDRAM device attributes: general	VCC10%, B/R, S/W, P/A, A/P		0Eh	
23	Minimum clock cycle time at CL=2 (tCYC)	15ns	10ns	F0h	A0h
24	Max. data access time form clock at CL=2 (tAC)	8ns	6ns	80h	60h
25	Minimum clock cycle time at CL=1 (tCYC)	—	—	00h	00h
26	Max. data access time from clock at CL=1 (tAC)	—	—	00h	00h
27	Minimum row precharge time (tRP)	20ns	20ns	14h	14h
28	Minimum row active to row active delay (tRRD)	20ns	20ns	14h	14h
29	Minumum RAS to CAS (tRCD)	20ns	20ns	14h	14h
30	Minumum RAS pulse width (tRAS)	50ns	50ns	32h	32h
31	Module bank density	256MB		40h	
32	Min. command and address signal setup time (tAS)	2ns		20h	
33	Min. command and address signal hold time (tAH)	1ns		10h	
34	Min. data signal input setup time (tDS)	2ns		20h	

continued on the next page

**SERIAL PRESENCE DETECT INFORMATION** *(continued)*Serial PD Interface Protocol: I<sup>2</sup>C; Current sink capability of SDA driver <=3mA; Maximum clock frequency: 100 KHz

Byte #	Function Described	Function Supported		Hex Value	
		C	D	C	D
35	Min. data signal input hold time (tDH)	1ns		10h	
36-61	Superset information (may be used in future)	—		00h	
62	SPD revision	1.2	1.2	12h	12h
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)	STEC's ID		A8h	
66-71				00h	
72	Manufacturing location	STEC USA or STEC Malaysia		01h (USA) or 02h	
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)		w w	
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	
99-125	Manufacturer's specific data			xxh	
126	Intel specification frequency	100MHz		64h	
127	Intel specification details	Detailed 100MHz Info		8Fh	8Fh

**ABSOLUTE MAXIMUM RATINGS\***

Item	Symbol	Rating	Units
Voltage on Any Pin Relative to VSS	V <sub>IN</sub> , V <sub>OUT</sub>	-1.0 to +4.6	V
Voltage on VCC Supply Relative to VSS	V <sub>DD</sub>	-1.0 to +4.6	V
Storage Temperature	T <sub>stg</sub>	-55 to +150	°C
Power Dissipation	P <sub>D</sub>	9	W
Short Circuit Output Current	I <sub>OS</sub>	50	mA

\* Permanent device damage may occur if "ABSOLUTE MAXIMUM RATINGS" are exceeded. Functional Operation should be restricted to the conditions as detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

**RECOMMENDED OPERATING CONDITIONS** (Voltage reference to V<sub>SS</sub>=0, T<sub>A</sub>=0 to 70°C)

Item	Symbol	Min	Typ	Max	Unit	Notes
Supply Voltage	V <sub>DD</sub>	3.0	3.3	3.6	V	
Input High Voltage	V <sub>IH</sub>	2.0	3.0	V <sub>DD</sub> +0.3	V	1
Input Low Voltage	V <sub>IL</sub>	-0.3	0	0.8	V	2
Output High Voltage Level	V <sub>OH</sub>	2.4	—	—	V	I <sub>OH</sub> =-4mA
Output Low Voltage Level	V <sub>OL</sub>	—	—	0.4	V	I <sub>OL</sub> =4mA
Input Leakage Current	I <sub>IL</sub>	-90	—	90	μA	3

**Notes:**

1. V<sub>IH</sub>(max)=5.6 V AC (pulse width <=3 ns acceptable)
2. V<sub>IL</sub>(min) = -2.0 V AC (pulse width <=3 ns acceptable)
3. Any input 0<=V<sub>IN</sub><=V<sub>DD</sub>.

**CAPACITANCE** (T<sub>A</sub>=23 °C, V<sub>DD</sub>=3.3V, f=1MHz, V<sub>REF</sub>=1.4±200mA)

Item	Symbol	Max	Units
Input Capacitance (A <sub>0</sub> -A <sub>10</sub> /AP, A <sub>11</sub> , A <sub>12</sub> , BA <sub>0</sub> , BA <sub>1</sub> )	C <sub>IN1</sub>	55	pF
Input Capacitance ( $\overline{\text{RAS}}$ , $\overline{\text{CAS}}$ , $\overline{\text{WE}}$ )	C <sub>IN2</sub>	55	pF
Input Capacitance (CLK <sub>0</sub> )	C <sub>IN3</sub>	12	pF
Input Capacitance (CKE <sub>0</sub> )	C <sub>IN4</sub>	55	pF
Input Capacitance ( $\overline{\text{S0}}$ )	C <sub>IN5</sub>	55	pF
Input Capacitance (DQMB <sub>0</sub> , DQMB <sub>2</sub> -DQMB <sub>7</sub> )	C <sub>IN6</sub>	15	pF
Input Capacitance (DQMB <sub>1</sub> )	C <sub>IN6</sub>	20	pF
Input/Output Capacitance (DQ <sub>0</sub> -DQ <sub>63</sub> , CB <sub>0</sub> -CB <sub>7</sub> )	C <sub>IO1</sub>	16.5	pF

**DC CHARACTERISTICS**

(Recommended operating conditions unless otherwise noted. TA=0 to 70°C)

Parameter	Symbol	Test Condition	Max	Units
Operating Current (One Bank Active)	ICC1S	Burst length=1, tRC>=tRC(min), IOL=0mA, Outputs open	990	mA
Precharge Standby Current in Power-Down Mode	ICC2P	CKE<=VIL(max), tCLK=10ns,	18	mA
	ICC2PS	CKE and CLK<=VIL(max), tCLK=infinity	18	mA
Precharge Standby Current in Non Power-Down Mode	ICC2N	CKE and S>=VIH(min), tCLK=10ns Input signals are changed one time during 20ns	144	mA
	ICC2NS	CKE>=VIH(min), CLK<=VIL(max), tCLK=infinity Input signals are stable	126	mA
Active Standby Current in Power-Down Mode	ICC3P	CKE<=VIL(max), tCLK=10ns	54	mA
	ICC3PS	CKE and CLK<=VIL(max), tCLK=infinity	54	mA
Active Standby Current in Non Power-Down Mode (One Bank Active)	ICC3N	CKE and S>=VIH(min), tCLK=10ns, Input signals are changed one time during 20ns	270	mA
	ICC3NS	CKE>=VIH(min), CLK<=VIL(max), tCLK=infinity Inputs are stable	225	mA
Operating Current (Burst Mode)	ICC4	IOL=0mA, Page Burst, 4 banks activated ICCD=2 CLKs, Outputs open	1035	mA
Refresh Current	ICC5	tRC>=tRC(min)	1800	mA
Self Refresh Current (Refresh Period is 64ms)	ICC6	CKE<=0.2V	45	mA

**AC TIMING PARAMETERS**

(AC operating conditions unless otherwise noted. Refer to the individual component, not the whole module.)

Parameter	Symbol	Min	Max	Unit	Notes	
Clock Period	CL=2 CL=3	tCYC	15/10* 10/10*	ns		
Clock High Time		tCH	3	ns	1	
Clock Low Time		tCL	3	ns		
Input Setup Times		tSI	2	ns		
Input Hold Times		tHI	1	ns		
Output Valid From Clock	CL=2 CL=3	tAC	8/6* 6/6*	6 6	ns ns	3 3
Output Hold From Clock		tOH	3	ns	4	
Output Valid to Z		tOHZ	3	9	ns	
CAS to CAS Delay		tCCD	1		tCLK	
CAS Bank Delay		tCBD	1		tCLK	
CKE to Clock Disable		tCKE	1		tCLK	
RAS Precharge Time		tRP	2		tCLK	5
RAS Active Time		tRAS	5		tCLK	
Active to Command Delay (RAS to CAS Delay)		tRCD	2		tCLK	6
RAS to RAS Bank Activate Delay		tRRD	2		tCLK	
RAS Cycle Time		tRC	7		tCLK	7
DQM to Input Data Delay		tDQD	0		tCLK	
Write Cmd. to Input Data Delay		tDWD	0		tCLK	
Mode Register set to Active Delay		tMRD	3		tCLK	
Precharge to O/P in High-Z		tROH	CL		tCLK	
DQM to Data in HiZ for Read		tDQZ	2		tCLK	
DQM to Data Mask for Write		tDQM	0		tCLK	8
Data-In to PRE Command Period		tDPL	2		tCLK	
Data-In to ACT (PRE) Command Period (Auto Precharge)		tDAL	5		tCLK	
Power Down Mode Entry		tSB		1	tCLK	
Self Refresh Exit Time		tSRX	1		tCLK	
Power Down Exit Setup Time		tPDE	1		tCLK	9
Clock Stop During Self Refresh or Power Down		tCLKSTP	200		tCLK	10

\* These values vary depending on the PC100 Option (see Ordering Information). Option C is the first value listed and Option D is the second.

AC TIMING PARAMETERS (continued)

Notes:

1. Rated @ 1.5V
2. Limited application, 2 banks, all outputs switching
3. LVTTTL levels, rated @ 50pF, all outputs switching, 5.2ns @ 0pF
4. 3ns @ 50pF, need 1.8ns @0pF
5.  $t_{RP}=2$  a SPD Option
6.  $t_{RCD}=2$  a SPD Option
7. 7 clks for  $t_{RP}=2$
8. Data Masked on the same clock.
9. Timing is asynchronous. If  $t_{SET}$  is not met by rising edge of CLK then CKE is assumed latched on next cycle.
10. If the clock is stopped during self refresh or powerdown, 200 clocks are required before CKE is high.

AC OPERATING TEST CONDITIONS

( $V_{DD} = 3.3V \pm 0.3V$ ,  $T_A = 0$  to  $65^\circ C$ )

Parameter	Value
AC input levels	$V_{IH}/V_{IL}=2.4V/0.4V$
Input timing measurement ref. level	1.4V
Input rise and fall time	$t_r/t_f=1ns/1ns$
Output measurement reference level	1.4V
Output load condition	See Figure 2.

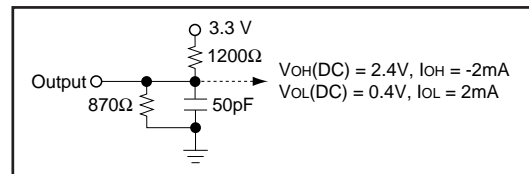


Figure 1. DC Output Load Circuit

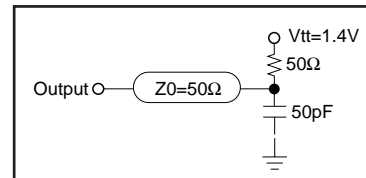


Figure 2. AC Output Load Circuit

## REVISION HISTORY

**Rev. Change Description from Previous Revision**

-105 08/07/2007. Logo updated.

-106 08/24/2007. U added to part number.

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