TENTATIVE TOSHIBA HYBRID DIGITAL INTEGRATED CIRCUIT

67,108,864-WORD BY 16-BIT (128M Bytes) Direct Rambus DRAM MODULE

DESCRIPTION

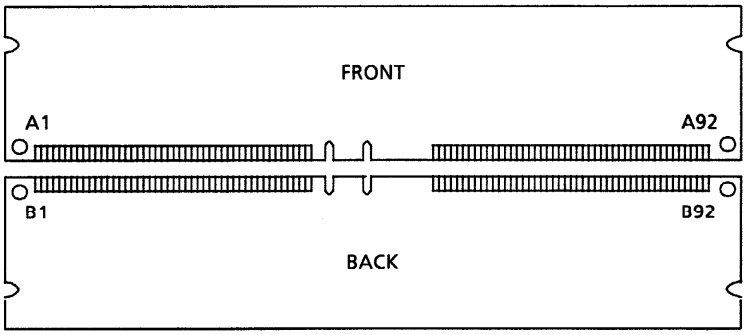
The THMR2N4Z is a 67,108,864-word by 16-bit direct rambus dynamic RAM module consisting of 4 TC59RM816MB Direct Rambus DRAMs on a printed circuit board.

FEATURES

	-6	-7	-8
Organization	64M-word×16 bit	64M-word×16 bit	64M-word×16 bit
I/O Frequency	600MHz	711MHz	800MHz
t_{RAC} (Row Access time)	53ns	45ns	45ns
Part Designator	256M (×16) -4CSP	256M (×16) -4CSP	256M (×16) -4CSP

- Power supply of 2.5V (±5%)
- 128MB Direct RDRAM storage
- Each RDRAM has 32 banks for 128 banks total on module
- Separate Row and Column buses for higher efficiency
- Package: 184pin DIMM
- Gold contacts
- Serial Presence Detect suport
- 6 layer PCB

PIN ASSIGNMENT (TOP VIEW)



A1	Gnd	B1	Gnd	A24	LCOL0	B24	LDQB0	A47	NC	B47	NC	A70	Gnd	B70	Gnd
A2	NC	B2	LDQA7	A25	Gnd	B25	Gnd	A48	NC	B48	NC	A71	RCOL2	B71	RCOL1
A3	Gnd	B3	Gnd	A26	LDQB1	B26	LDQB2	A49	NC	B49	NC	A72	Gnd	B72	Gnd
A4	LDQA6	B4	LDQA5	A27	Gnd	B27	Gnd	A50	NC	B50	NC	A73	RCOL4	B73	RCOL3
A5	Gnd	B5	Gnd	A28	LDQB3	B28	LDQB4	A51	Vref	B51	Vref	A74	Gnd	B74	Gnd
A6	LDQA4	B6	LDQA3	A29	Gnd	B29	Gnd	A52	Gnd	B52	Gnd	A75	RROW1	B75	RROW0
A7	Gnd	B7	Gnd	A30	LDQB5	B30	LDQB6	A53	SCL	B53	SA0	A76	Gnd	B76	Gnd
A8	LDQA2	B8	LDQA1	A31	Gnd	B31	Gnd	A54	Vdd	B54	Vdd	A77	NC	B77	RROW2
A9	Gnd	B9	Gnd	A32	LDQB7	B32	NC	A55	SDA	B55	SA1	A78	Gnd	B78	Gnd
A10	LDQA0	B10	LCFM	A33	Gnd	B33	Gnd	A56	SVdd	B56	SVdd	A79	RCTM	B79	NC
A11	Gnd	B11	Gnd	A34	LSCK	B34	LCMD	A57	SWP	B57	SA2	A80	Gnd	B80	Gnd
A12	LCTMN	B12	LCFMN	A35	Vcmos	B35	Vcmos	A58	Vdd	B58	Vdd	A81	RCTMN	B81	RCFMN
A13	Gnd	B13	Gnd	A36	SOUT	B36	SIN	A59	RSCK	B59	RCMD	A82	Gnd	B82	Gnd
A14	LCTM	B14	NC	A37	Vcmos	B37	Vcmos	A60	Gnd	B60	Gnd	A83	RDQA0	B83	RCFM
A15	Gnd	B15	Gnd	A38	NC	B38	NC	A61	RDQB7	B61	NC	A84	Gnd	B84	Gnd
A16	NC	B16	LROW2	A39	Gnd	B39	Gnd	A62	Gnd	B62	Gnd	A85	RDQA2	B85	RDQA1
A17	Gnd	B17	Gnd	A40	NC	B40	NC	A63	RDQB5	B63	RDQB6	A86	Gnd	B86	Gnd
A18	LROW1	B18	LROW0	A41	Vdd	B41	Vdd	A64	Gnd	B64	Gnd	A87	RDQA4	B87	RDQA3
A19	Gnd	B19	Gnd	A42	Vdd	B42	Vdd	A65	RDQB3	B65	RDQB4	A88	Gnd	B88	Gnd
A20	LCOL4	B20	LCOL3	A43	NC	B43	NC	A66	Gnd	B66	Gnd	A89	RDQA6	B89	RDQA5
A21	Gnd	B21	Gnd	A44	NC	B44	NC	A67	RDQB1	B67	RDQB2	A90	Gnd	B90	Gnd
A22	LCOL2	B22	LCOL1	A45	NC	B45	NC	A68	Gnd	B68	Gnd	A91	NC	B91	RDQA7
A23	Gnd	B23	Gnd	A46	NC	B46	NC	A69	RCOL0	B69	RDQB0	A92	Gnd	B92	Gnd

000707EBA1

PIN NAMES

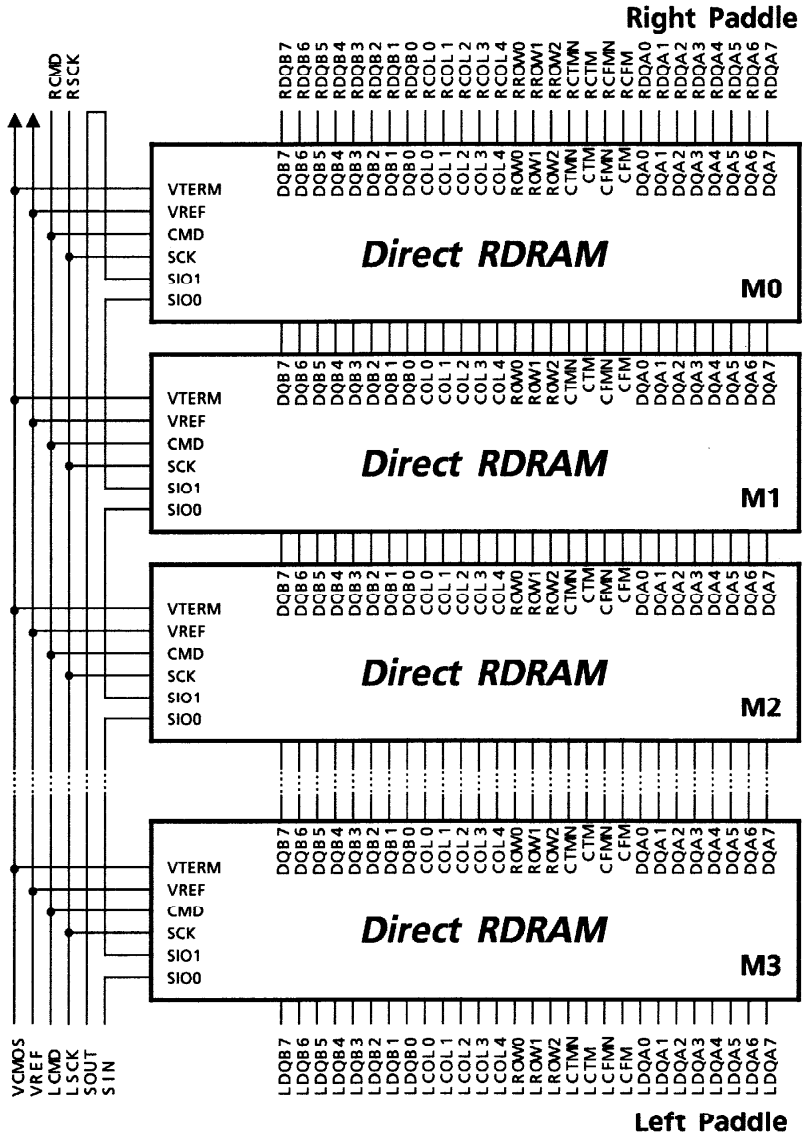
Signal	I/O	Type	Description	Pins
SIN	I/O	CMOS	Serial I/O. Pin for reading from and writing to the control registers.	B36
SOUT	I/O	CMOS	Serial I/O. Pin for reading from and writing to the control registers.	A36
VDD			Supply voltage for the RDRAM core and interface logic.	A41, B41, A42, B42,A54, B54, A58, B58
GND			Ground reference for RDRAM core and interface.	A1, B1, A3, B3, A5, B5, A7, B7, A9, B9, A11, B11, A13, B13, A15, B15, A17, B17, A19 B19, A21, B21, A23, B23, A25 B25, A27, B27, A29, B29, A31 B31, A33, B33, A39, B39, A52, B52, A60, B60,A62, B62, A64, B64, A66, B66, A68, B68 A70, B70, A72, B72, A74, B74 A76, B76, A77, A78, B78, A80, B80, A82, B82, A84, B84 A86, B86, A88, B88, A90, B90 A92, B92
LDQA7 to 0	I/O	RSL	Data bus A. A 8-pin bus carrying a byte of read or write data between the Channel and the RDRAM.	B2, A4, B4, A6, B6, A8, B8, A10
LCFM	I	RSL	Clock from master. Interface clock used for receiving RSL signals from the Channel. Positive polarity.	B10
LCFMN	I	RSL	Clock from master. Interface clock used for receiving RSL signals from the Channel. Negative polarity.	B12
	VREF		Logic threshold reference voltage for RSL signals.	A51, B51
LCTMN	I	RSL	Clock to master. Interface clock used for taransmitting RSL signals to the Channel. Negative polarity.	A12
LCTM	I	RSL	Clock to master. Interface clock used for transmitting RSL signals to the Channel. Positibe polarity.	A14
LROW2 to 0	I	RSL	Row bus. 3-pin bus containing control and address information for row accesse.	B16, A18, B18
LCOL4 to 0	I	RSL	Column bus. 5-pin bus containing contorol and address information for column accesses.	A20, B20, A22, B22, A24
LDQB7 to 0	I/O	RSL	Data bus B. A 8-bit bus carrying a byte of read or write data between the Channel and the RDRAM.	A32, B30, A30, B28, A28, B26, A26, B24
LCMD	I	CMOS	Serial Command Pin. Pin used to read from and write to the control registers. Also used for power management.	B34
LSCK	I	CMOS	Clock input. Pin used to read from and write to the control registers.	A34
RDQA7 to 0	I/O	RSL	Data bus A. A 8-pin bus carrying a byte of read or write data between the Channel and the RDRAM.	B91, A89, B89, A87, B87, A85, B85, A83
RCFM	I	RSL	Clock from master. Interface clock used for receiving RSL signals from the Channel. Positive polarity.	B83
RCFMN	I	RSL	Clock from master. Interface clock used for receiving RSL signals from the Channel. Negative polarity.	B81
RCTM	I	RSL	Clock to master. Interface clock used for transmitting RSL signals to the Channel. Positive polarity.	A79
RROW2 to 0	I	RSL	Row bus. 3-pin bus containing control and address information for row accesses.	B77, A75, B75
RCOL4 to 0	I	RSL	Column bus. 5-pin bus containing control and address information for column accesses.	A73, B73, A71, B71, A69
RDQB7 to 0	I/O	RSL	Data bus B. A 8-bit bus carrying a byte of read or write data between the Channel and the RDRAM.	A61, B63, A63, B65, A65, B67 A67, B69
RCMD	I	CMOS	Serial Command Input. Pin used to read from and write to the control registers. Also used for power manegement.	B59
RSCK	I	CMOS	Clock input. Pin used to read from and write to the control registers.	A59
SCL	I	CMOS	Serial Presence Detect Clock.	A53
SDA	I/O	CMOS	Serial Presence Detect Data (Open Collector I/O).	A55
SA0	I	CMOS	Serial Presence Detect Address 0.	B53
SA1	I	CMOS	Serial Presence Detect Address 1.	B55
SA2	I	CMOS	Serial Presence Detect Adderss 2.	B57
SWP	I	CMOS		A57
VCMOS			Termination Voltage.	A37, B37, A35, B35
SVDD			Supply voltage for the E^2PROM (SPD).	A56, B56
N.C.				B14, A16, A38, B38, A40, B40 A43, B43, A44, B44, A45, B45 A46, B46, A47, B47, A48, B48 A49, B49, A50, B50, B79,

SERIAL PRESENCE DETECT

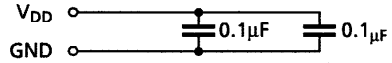
Byte Number	Function	THMR2N4Z-6 64Mx16 (128MB), 600MHz-53ns		THMR2N4Z-7 64Mx16 (128MB), 711MHz-45ns		THMR2N4Z-8 64Mx16 (128MB), 800MHz-45ns	
		Entry Value	Entry	Entry Value	Entry	Entry Value	Entry
0	SPD revision level	1.0	02 h	1.0	02 h	1.0	02 h
1	Total number of bytes in the SPD	256 bytes	08 h	256 bytes	08 h	256 bytes	08 h
2	Device type	DRDRAM	01 h	DRDRAM	01 h	DRDRAM	01 h
3	Module type	RIMM	01 h	RIMM	01 h	RIMM	01 h
4	Row address bit, Column address bit	9.7	97 h	9.7	97 h	9.7	97 h
5	Bank address bits and byte	32 s	C5 h	32 s	C5 h	32 s	C5 h
6	Refresh bank bit	5	05 h	5	05 h	5	05 h
7	tREF-Refresh interval	32	20 h	32	20 h	32	20 h
8	Protocol version	2	02 h	2	02 h	2	02 h
9	Miscellaneous device configuration field (Low Power/no-Low Power)	1.5 tSCK S28IECO	05 h	1.5 tSCK S28IECO	05 h	1.5tSCK S28IECO	05 h
10	tRP-R, Min	8 Cycle	08 h	8 Cycle	08 h	8 Cycle	08 h
11	tRAS-R, Min	20 Cycle	14 h	20 Cycle	14 h	20 Cycle	14 h
12	tRCD-R, Min	8 Cycle	08 h	8 Cycle	08 h	10 Cycle	0A h
13	tRR-R, Min	8 Cycle	08 h	8 Cycle	08 h	8 Cycle	08 h
14	tPP-R, Min	8 Cycle	08 h	8 Cycle	08 h	8 Cycle	08 h
15	Min tCYCLE for range A	3.33 ns	1A h	3.33 ns	15 h	3.33 ns	13 h
16	Max tCYCLE for range A	3.71 ns	1E h	3.71 ns	1E h	3.71 ns	1E h
17	tCDLY range for A	4 - 9	49 h	5 - 9	59 h	5 - 9	59 h
18	tCLS and tCAS range for A	tCLS = 2 tCAS = 2	AA h	tCLS = 2, tCAS = 2	AA h	tCLS = 2, tCAS = 2	AA h
19	Min tCYCLE for range B	—	00 h	3.33 ns	1A h	3.33 ns	1A h
20	Max tCYCLE for range B	—	00 h	3.71 ns	1E h	3.71 ns	1E h
21	tCDLY range for range B	—	00 h	4 - 9	49 h	4 - 9	49 h
22	tCLS and tCAS range for range B	—	00 h	tCLS = 2, tCAS = 2	AA h	tCLS = 2, tCAS = 2	AA h
23	Min tCYCLE range for C	—	00 h	—	00 h	—	00 h
24	Max tCYCLE for range C	—	00 h	—	00 h	—	00 h
25	tCDLY range for range C	—	00 h	—	00 h	—	00 h
26	tCLS and tCAS range for range C	—	00 h	—	00 h	—	00 h
27	Min tCYCLE for range D	—	00 h	—	00 h	—	00 h
28	Max tCYCLE for range D	—	00 h	—	00 h	—	00 h
29	tCDLY range for range D	—	00 h	—	00 h	—	00 h
30	tCLS and tCAS range for range D	—	00 h	—	00 h	—	00 h
31	tPDNXA, Min	4 us	04 h	4 us	04 h	4 us	04 h
32	tPDNXA, Max	9000 Cycles	8D h	9000 Cycles	8D h	9000 Cycles	8D h
33	tNAPXA, Min	50 ns	32 h	50 ns	32 h	50 ns	32 h
34	tNAPXB, Min	40 ns	28 h	40 ns	28 h	40 ns	28 h
35	fIMIN [11:8] , fIMAX [11:8]	261,300MHz	11 h	261,357MHz	11 h	261,400MHz	11 h
36	fIMIN [7:0]	261MHz	05 h	261MHz	05 h	261MHz	05 h
37	fIMAX [7:0]	300MHz	2C h	357MHz	65 h	400MHz	90 h
38	ODF Mapping	12.5%	01 h	12.5%	01 h	12.5%	01 h
39	tCCTRL, MAX	100 ms	64 h	100 ms	64 h	100 ms	64 h
40	tTEMP, MAX	100 ms	64 h	100 ms	64 h	100 ms	64 h
41	tTCEN, MIN	150 tCYCLE	96 h	150 tCYCLE	96 h	150 tCYCLE	96 h
42	tRAS-R, MAX	64 us	40 h	64 us	40 h	64 us	40 h
43	tNLIMIT, MAX	10 us	0A h	10 us	0A h	10 us	0A h
44	ACTREFPT, PCHRERPT	6.6 tCYCLE	66 h	6.6 tCYCLE	66 h	6.6 tCYCLE	66 h
45	CPCHREFPT_DC, RDREFPT_DC	5.5 tCYCLE	55 h	5.5 tCYCLE	55 h	5.5 tCYCLE	55 h
46	RETREFPT_DC, WRREFPT_DC	5.13 tCYCLE	5D h	5.13 tCYCLE	5D h	5.13 tCYCLE	5D h
47-49	Reserved		00 h		00 h		00 h
50	fRAS [11:8]	300MHz	01 h	357MHz	01 h	400MHz	01 h
51	fRAS [7:0]	300MHz	2C h	357MHz	65 h	400MHz	90 h
52	PMAX, HI, PMAX, LO, TJ	0,0,100degC	24 h	0,0,100degC	24 h	0,0,100degC	24 h
53	Heat Spreader, Tplate	1,90degC	9A h	1,90degC	9A h	1,90degC	9A h

Byte Number	Function	THMR2N4Z-6 64Mx16 (128MB), 600MHz-53ns		THMR2N4Z-7 64Mx16 (128MB), 711MHz-45ns		THMR2N4Z-8 64Mx16 (128MB), 800MHz-45ns	
		Entry Value	Entry	Entry Value	Entry	Entry Value	Entry
54	PSTBY, HI	90 mA	5A h	95 mA	5F h	105 mA	69 h
55	PACTI, HI	125 mA	3F h	140 mA	46 h	150 mA	4B h
56	PACTRW, HI	450 mA	39 h	520 mA	41 h	575 mA	48 h
57	PSTBY, LO	85 mA	55 h	85 mA	55 h	85 mA	55 h
58	PACTI, LO	115 mA	3A h	115 mA	3A h	115 mA	3A h
59	PACTRW, LO	410 mA	34 h	410 mA	34 h	410 mA	34 h
60	PNAP	4.2 mA	21 h	4.2 mA	21 h	4.2 mA	21 h
61	PRESA		00 h		00 h		00 h
62	PRESB		00 h		00 h		00 h
63	Checksum for location 0-62		82 h		3E h		AA h
64		TOSHIBA	98 h	TOSHIBA	98 h	TOSHIBA	98 h
65-71			00 h		00 h		00 h
72	Module manufacturing location						
73-90	Module part number						
91-92	Module revision code		00 h		00 h		00 h
93	Module manufacturing year						
94	Module manufacturing week						
95-98	Module serial number						
99	Number of devices on module	4	04 h	4	04 h	4	04 h
100	Module data width	16	10 h	16	10 h	16	10 h
101	Device enables	All 4 device enabled	0F h	All 4 device enabled	0F h	All 4 device enabled	0F h
102			00 h		00 h		00 h
103			00 h		00 h		00 h
104			00 h		00 h		00 h
105	Module Vdd, Module Voltage Interface level	2.5V,1.8V	10 h	2.5V,1.8V	10 h	2.5V,1.8V	10 h
106	Module VDD tolerance	5% DC 2% AC	52 h	5% DC 2% AC	52 h	5% DC 2% AC	52 h
107-113	Reserved		00 h		00 h		00 h
114	CDLY0/1 for tCDLY = 3	–	00 h	–	00 h	–	00 h
115	CDLY0/1 for tCDLY = 4	2 / 0	20 h	2 / 0	20 h	2 / 0	20 h
116	CDLY0/1 for tCDLY = 5	3 / 0	30 h	3 / 0	30 h	3 / 0	30 h
117	CDLY0/1 for tCDLY = 6	3 / 1	31 h	3 / 1	31 h	3 / 1	31 h
118	CDLY0/1 for tCDLY = 7	3 / 2	32 h	3 / 2	32 h	3 / 2	32 h
119	CDLY0/1 for tCDLY = 8	4 / 2	42 h	4 / 2	42 h	4 / 2	42 h
120	CDLY0/1 for tCDLY = 9	5 / 2	52 h	5 / 2	52 h	5 / 2	52 h
121	CDLY0/1 for tCDLY = 10	–	00 h	–	00 h	–	00 h
122	CDLY0/1 for tCDLY = 11	–	00 h	–	00 h	–	00 h
123	CDLY0/1 for tCDLY = 12	–	00 h	–	00 h	–	00 h
124	CDLY0/1 for tCDLY = 13	–	00 h	–	00 h	–	00 h
125	CDLY0/1 for tCDLY = 14	–	00 h	–	00 h	–	00 h
126	CDLY0/1 for tCDLY = 15	–	00 h	–	00 h	–	00 h
127	Checksum for location 99-126		CC h		CC h		CC h

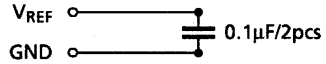
BLOCK DIAGRAM



<M0-3>

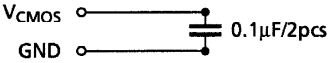


<M0-3>

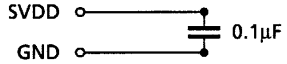


Plus one
Near Connector

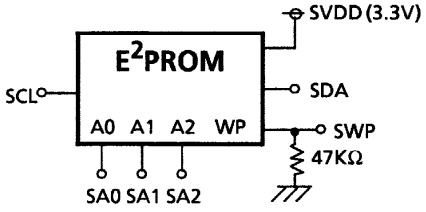
<M0-3>



<E²PROM>



Serial Presence Detect



ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER	MIN	MAX	UNIT
$V_{I, ABS}$	Voltage applied to any RSL pin with respect to Gnd	-0.3	V_{DD} + 0.3	V
$V_{I, CMOS, ABS}$	Voltage applied to any CMOS pin with respect to Gnd	-0.3	V_{DD} + 0.3	V
$V_{DD, ABS}$	Voltage on VDD with respect to Gnd	-0.5	V_{DD} + 1.0	V
T_{STORE}	Storage temperature	-50	100	°C

THERMAL PARAMETERS

SYMBOL	PARAMETER and CONDITIONS	MIN	MAX	UNIT
T_J	Junction operating temperature	TBD	TBD	°C
θ_{JA}	Jution-to-Ambient thermal resistance		TBD	°C/Watt

RIMM MODULE CURRENT PROFILE

I_{DD}	RIMM module power conditions	MAX	UNIT
I_{DD1}	One RDRAM in Read, balance in NAP mode	580	mA
I_{DD2}	One RDRAM in Read, balance in Standby mode	870	mA
I_{DD3}	One RDRAM in Read, balance in Active mode	1011	mA
I_{DD4}	One RDRAM in Write, balance in NAP mode	588	mA
I_{DD5}	One RDRAM in Write, balance in Standby mode	878	mA
I_{DD6}	One RDRAM in Write, balance in Active mode	1019	mA

Power does not include Refresh Current

RECOMMENDED CONDITIONS

SYMBOL	PARAMETER and CONDITIONS	MIN	MAX	UNIT
V_{DD}	Supply Voltage	2.50-0.13	2.50 + 0.13	V
V_{CMOS}	CMOS I/O power supply at pad for 2.5V controllers:	2.5 - 0.13	2.5 + 0.25	V
	CMOS I/O power supply at pad for 1.8V controllers:	1.8 - 0.1	1.8 + 0.2	V
V_T	Termination Voltage	1.80-0.1	1.80 + 0.1	V
V_{REF}	Reference Voltage	1.40-0.2	1.40 + 0.2	V
V_{IL}	RSL input low Voltage	V_{REF}-0.5	V_{REF}-0.2	V
V_{IH}	RSL input high Voltage	V_{REF} + 0.2	V_{REF} + 0.5	V
$V_{IL, COMS}$	CMOS input low Voltage	-0.3	$0.5V_{CMOS}$ - 0.25	V
$V_{IH, CMOS}$	CMOS input high Voltage	$0.5V_{CMOS}$ + 0.25	V_{CMOS} + 0.3	V
SV_{DD}	SPD power supply	2.2	3.6	V
V_{SIL}	SPD input low Voltage	-0.3	SV_{DD} x 0.3	V
V_{SIH}	SPD input high Voltage	SV_{DD} x 0.7	SV_{DD} + 0.3	V

ELECTRICAL CHARACTERISTICS

SYMBOL	PARAMETER and CONDITIONS	MIN	MAX	UNIT
I_{REF}	V_{REF} current @ $V_{REF, MAX}$	-40	40	μA
$I_{SCK, CMD}$	CMOS input leakage current @ ($0 \leqq V_{CMOS} \leqq V_{DD}$)	-40	40	μA
$I_{SIN, SOUT}$	CMOS input leakage current @ ($0 \leqq V_{CMOS} \leqq V_{DD}$)	-10	10	μA
$V_{OL, CMOS}$	CMOS output Voltage @ $I_{OL, CMOS}$ = 1.0mA	-	0.3	V
$V_{OH, CMOS}$	CMOS output high Voltage @ $I_{OH, CMOS}$ = -0.25mA	V_{CMOS} - 0.3	-	V
V_{SOL}	SPD output low Voltage (I_{SOL} = 3mA)		0.4	V

TIMING CHARACTERISTICS

SYMBOL	PARAMETER	MIN	MAX	UNIT
t_Q	CTM-to-DQA/DQB output time @ t_{CYCLE} = 3.33ns	-0.350[a,c]	+0.350[a,c]	ns
	CTM-to-DQA/DQB output time @ t_{CYCLE} = 2.81ns	-0.300[b,c]	+0.300[b,c]	ns
	CTM-to-DQA/DQB output time @ t_{CYCLE} = 2.50ns	-0.260[c]	+0.260[c]	ns
t_{QR}, t_{QF}	DQA/DQB output rise and fall times	0.2	0.45	ns
t_{Q1}	SCK(neg)-to-SIO0 delay @ $C_{LOAD,MAX}$ = 20pF (SD read data valid).	-	10	ns
t_{HR}	SCK(pos)-to-SIO0 delay @ $C_{LOAD,MAX}$ = 20pF (SD read data hold).	2	-	ns
t_{QR1},t_{QF1}	SIO_{OUT} rise/fall @ $C_{LOAD,MAX}$ = 20pF	-	5	ns
t_{PROP1}	SIO0-to-SIO1 or SIO1-to-SIO0 delay @ $C_{LOAD,MAX}$ = 20pF	-	10	ns
t_{NAPXA}	NAP exit delay - phase A	-	50	ns
t_{NAPXB}	NAP exit delay - phase B	-	40	ns
t_{PDNXA}	PDN exit delay - phase A	-	4	μs
t_{PDNXB}	PDN exit delay - phase B	-	9000	t_{CYCLE}
t_{AS}	ATTN-to-STBY power state delay	-	1	t_{CYCLE}
t_{SA}	STBY-to-ATTN power state delay	-	0	t_{CYCLE}
t_{ASN}	ATTN/STBY-to-NAP power state delay	-	8	t_{CYCLE}
t_{ASP}	ATTN/STBY-to-PDN power state delay	-	8	t_{CYCLE}

a. This parameter also applies to a -800 or -711 part when operated with t_{CYCLE} = 3.33ns.

b. This parameter also appllies to a -800 part when operated with t_{CYCLE} = 2.81ns.

c. $t_{Q,MIN}$ and $t_{Q,MAX}$ for other t_{CYCLE} values can be interpolated between or extrapolated from the timings at the 3 specified t_{CYCLE} values.

RECOMMENDED TIMING CONDITIONS

SYMBOL	PARAMETER		MIN	MAX	UNIT
t_{CR}, t_{CF}	CTM and CFM input rise and fall times		0.2	0.5	ns
t_{CYCLE}	CTM and CFM cycle times	600	3.33	3.83	ns
		711	2.80	3.83	ns
		800	2.50	3.83	ns
t_{CH}, t_{CL}	CTM and CFM high and low times		40%	60%	t_{CYCLE}
t_{TR}	CTM-CFM differential	MSE/MS = 0/0	0.0	1.0	t_{CYCLE}
		MSE/MS = 1/1	0.9	1.0	t_{CYCLE}
t_{DR}, t_{DF}	DQA/DQB/ROW/COL input rise/fall times		0.2	0.65	ns
t_S, t_H	DQA/DQB/ROW/COL-to-CFM set/hold @ tCYCLE = 3.33ns		0.275	-	ns
	DQA/DQB/ROW/COL-to-CFM set/hold @ tCYCLE = 2.81ns		0.240	-	ns
	DQA/DQB/ROW/COL-to-CFM set/hold @ tCYCLE = 2.50ns		0.200	-	ns
t_{DR1}, t_{DF1}	SIO_{IN}[a], CMD, SCK input rise and fall times		-	5.0	ns
t_{CYCLE1}	SCK cycle time-Serial control register transactions		1000	-	ns
	SCK cycle time-Power transitions		10	-	ns
t_{CH1}, t_{CL1}	SCK high and low times		4.25	-	ns
t_{S1}	CMD setup time		1.25	-	ns
t_{H1}	CMD hold time		1	-	ns
t_{S2}	SIO_{IN} setup time		40	-	ns
t_{H2}	SIO_{IN} hold time		40	-	ns
t_{S3}	PDEV setup time on DQA5..0		0	-	ns
t_{H3}	PDEV hold time on DQA5..0		5.5	-	ns
t_{S4}	ROW2..0, COL4..0 setup time for quiet window		-1	-	t_{CYCLE}
t_{H4}	ROW2..0, COL4..0 hold time for quiet window		5	-	t_{CYCLE}
t_{CE}	CTM/CFM stable before NAP/PDN exit		2	-	t_{CYCLE}
t_{CD}	CTM/CFM stable after NAP/PDN entry		100	-	t_{CYCLE}
t_{FRM}	ROW packet to COL packet ATTN framing delay		7	-	t_{CYCLE}
t_{NLIMIT}	Maximum time in NAP mode			10.0	µs
t_{REF}	Refresh interval			32	ms
t_{RAS}	RAS interval (time a row may stay activated)			64[b]	µs
t_{PAUSE}	RDRAM substrate bias generator delay			200.0	µs

a. SIO_{IN} refers to the SIO0 or SIO1 pin when used as an input.

b. This is contraint imposed by the core, and is therefore in units of µs rather than t_{CYCLE}.

RECOMMENDED TIMING CONDITIONS

SYMBOL	PARAMETER	MIN-6	MIN-7	MIN-8			MAX	UNIT
t_{RC}	Row CYcle time of RDRAM banks-the interval betwee ROWA packets with ACT commands to the same bank.	28	28	28			-	t_{CYCLE}
t_{RAS}	RAS-asserted time of RDRAM bank-the interval between ROWA packet with ACT command and next ROWR packet with PRER command to the same bank.	20	20	20			-	t_{CYCLE}
t_{RP}	Row Precharge time of RDRAM banks-the interbal between ROWR packet with PRER command and next ROWA packet with ACT command to the same bank.	8	8	8			-	t_{CYCLE}
t_{PP}	Precharge-to-precharge time of RDRAM device-the interval between successive ROWR packets with PRER commands to different banks of the same device.	8	8	8			-	t_{CYCLE}
t_{RR}	RAS-to-RAS time of RDRAM device-the interbal between successive ROWA packets with ACT commands to different banks of the same device.	8	8	8			-	t_{CYCLE}
t_{RCD}	RAS-toCAS Delay-the interval from ROWA packet with ACT command to COLC paket with RD or WR command). Note-the RAS-to-CAS delay seen by the RDRAM core ($t_{RCD, CORE}$) is equal to $t_{RCD, CORE} = 1 + t_{RCD}$ because of differences in the row and column paths through the RDRAM interface.	7	7	9			-	t_{CYCLE}
t_{RAC}	RAS Acess delay-effective interval from ROWA packet with ACT command to Q read data. This is equal to : $t_{RAC} = 1 + t_{RCD} + t_{CAC}$.	16	16	18			-	t_{CYCLE}
t_{CAC}	CAS Access delay-the minimum interval from RD command to Q read data.	8	8	8			12	t_{CYCLE}
t_{CWD}	CAS Write Delay (interval from WR command to D write data.	6	6	6			6	t_{CYCLE}
t_{CC}	CAS-to-CAS time of RDRAM bank-the interval between successive COLC commands.	4	4	4			-	t_{CYCLE}
t_{PACKET}	Length of ROWA, ROWR, COLC, COLM or COLX packet.	4	4	4			4	t_{CYCLE}
t_{RTR}	Interval from COLC packet with WR command to COLC packet which causes retire, and to optional COLM packet with bytemask.	8	8	8			-	t_{CYCLE}
t_{OFFP}	Interval from last COLC packet with RD or automatic retier command to ROWR packet with PRER. Also, the interval (offset) from COLC packet with RDA command, or from COLC packet with retire command(after WRA automatic precharge), or from COLX packet with PREX command to the equivalent ROWR packet with PRER.	4	4	4				t_{CYCLE}

RSL CLOCKING AND BIT TRANSPOT

Figure 2 shows the timing required to receive or transmit a pair of RSL bits. A single clock cycle T_2 from the central figure is expanded to show the details associated with a falling edg e and rising edge of the CFM and CTM clock inputs (the CFMN and CTMN inputs will always be at the opposite signal level). Note that RSL signals are low-true ; a high voltage is logic zero.

Figure 2a shows the rise/fall requirements of RSL input signals, and the rise/fall characterisitics of RSL output signals.

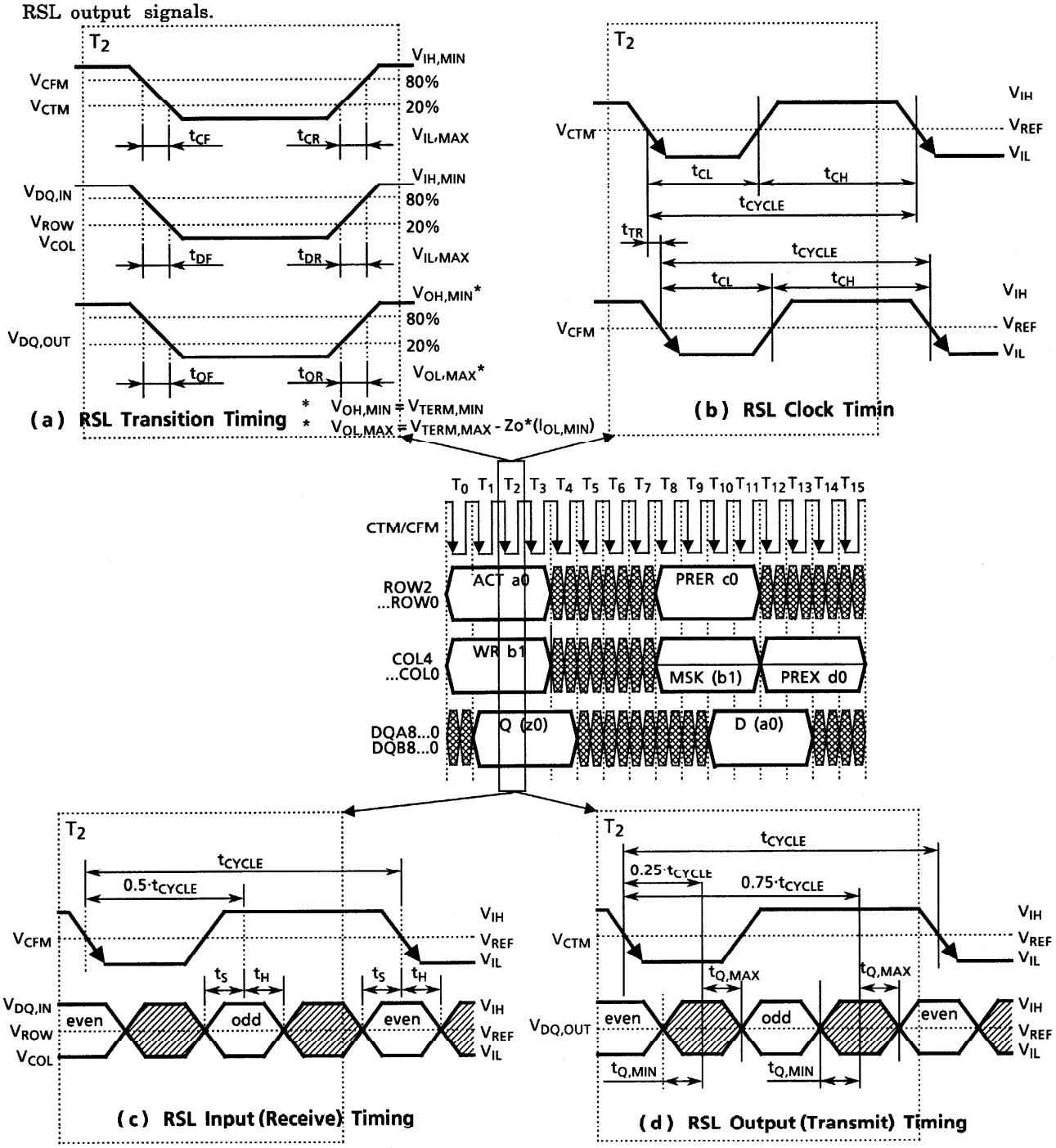


Figure 2: RSL Timing - Clocking and Bit Transport

Figure 2b shows the duty cycle requirements of the RSL clock inputs. It also shows the t_{TR} skew parameter (the amount of time by which CTM may lead CFM).

Figure 2c shows the setup and hold requirements of RSL inputs. Even bits are sampled on the falling edge of CFM and odd bits are sampled at the half-cycle (50%) point. The RDRAM synthesizes the 25%, 50%, and 75% timing points so that tow bits may be received or transmitted per clock cycle per signal wire.

Figure 2d shows the valid window of RSL outputs. Even bits are driven from the 75% point and odd bits from the 25% point.

CMOS CLOCKING AND BIT TRANSPORT

Figure 3 shows the timing required to receive or transmit a CMOS bit. A single clock cycle is expanded to show the details associated with a falling edge of the SCK clock input. Note that all CMOS signals are lowtrue ; a high voltage is logic zero.

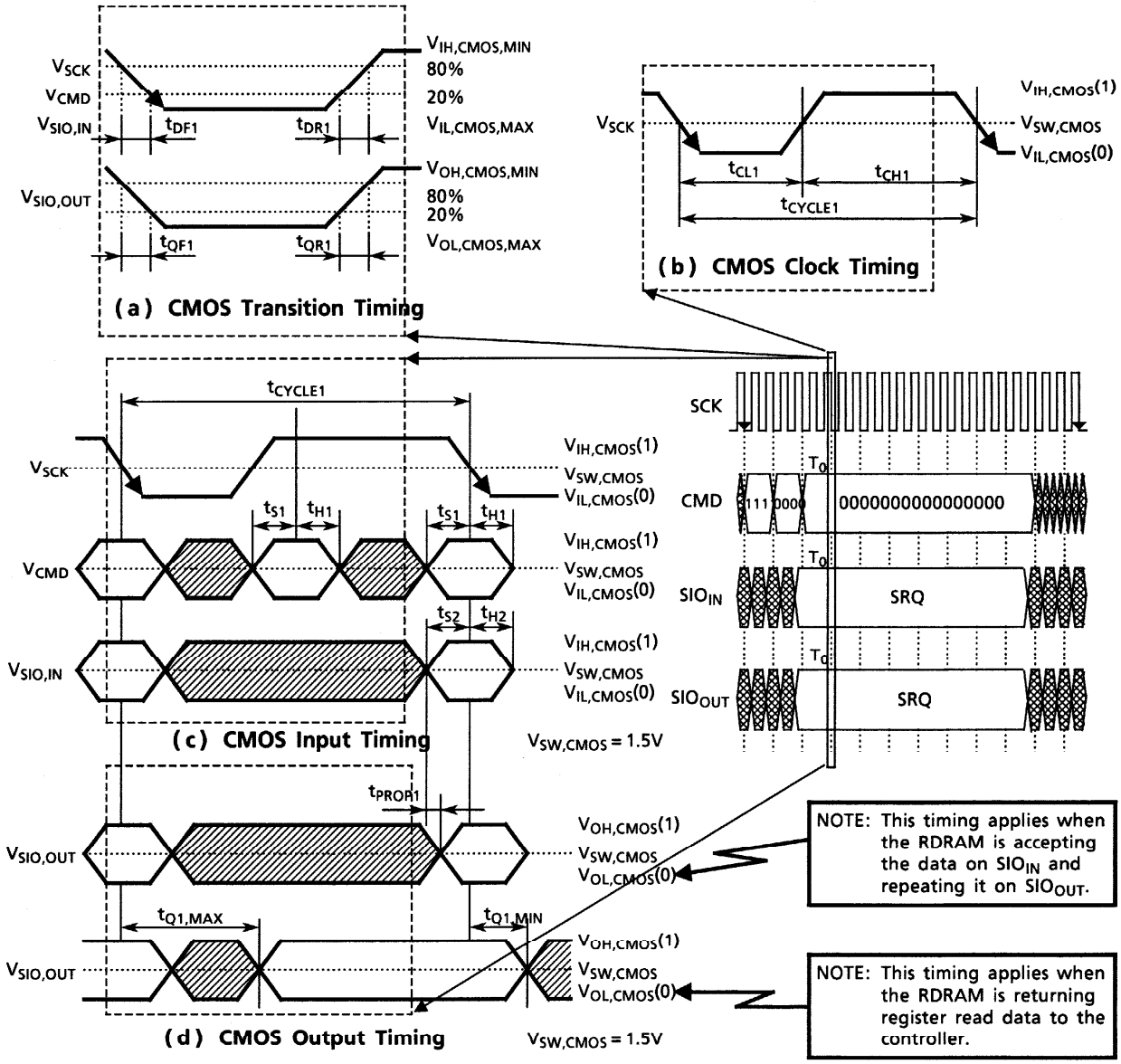


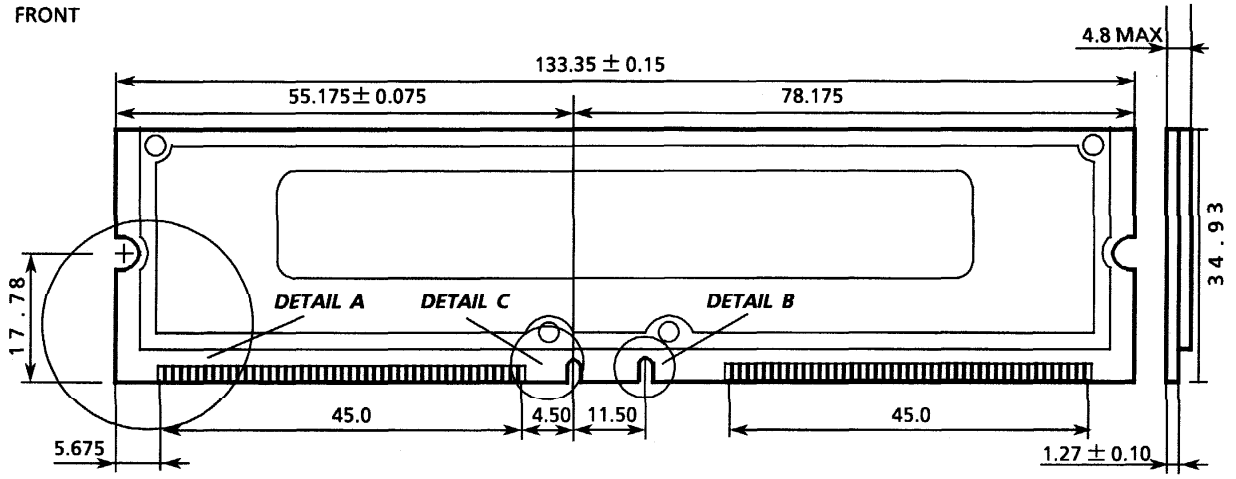
Figure 3: CMOS Timing-Clocking and Bit Transpot

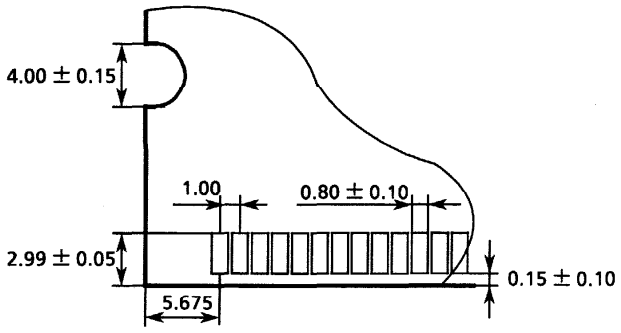
PACKAGE DIMENSIONS (THMR2N4Z)

Unit: mm

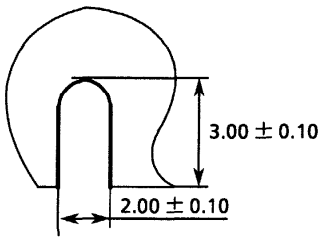
The dimensions without tolerance specification use the defalt tolerance of ±0.127.

FRONT

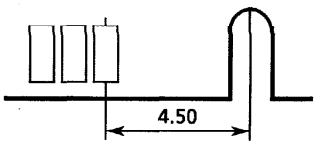




DETAIL A



DETAIL B



DETAIL C