Revision History

Revision .0 (February 1998)

- Input leakage Currents (Inputs / DQ) of Component level are changed.
  I_{IL}(Inputs) : ± 5uA to ± 1uA, I_{IL}(DQ) : ± 5uA to ± 1.5uA.
- Cin to be measured at V_{DD} = 3.3V, T_A = 23°C, f = 1MHz, V_{REF} =1.4V ± 200 mV.

Revision .1 (March 1998)

- Some Parameter values & Characteristics of comp. level are changed as below :
  - AC Operating Condition is changed as defined :
    V_{IH}(max) = 5.6V AC. The overshoot voltage duration is ≤ 3ns.
    V_{IL}(min) = -2.0V AC. The undershoot voltage duration is ≤ 3ns.
  - I_{CC3}PS is changed 1mA to 2mA.

Revision .2 (March 1998)

- I_{CC2}N, I_{CC2}NS, I_{CC3}N & I_{CC3}NS in comp. level values are changed.

Revision .3 (July 1998)

- Package Dimensions is revised.

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KMM366S1623BT SDRAM DIMM

16Mx64 SDRAM DIMM based on 8Mx8, 4Banks, 4K Refresh, 3.3V Synchronous DRAMs with SPD

GENERAL DESCRIPTION

The Samsung KMM366S1623BT is a 16M bit x 64 Synchronous Dynamic RAM high density memory module. The Samsung KMM366S1623BT consists of sixteen CMOS 8M x 8 bit with 4banks Synchronous DRAMs in TSOP-II 400mil package and a 2K EEPROM in 8-pin TSSOP package on a 168-pin glass-epoxy substrate. Two 0.1uF decoupling capacitors are mounted on the printed circuit board in parallel for each SDRAM.

The KMM366S1623BT is a Dual In-line Memory Module and is intended for mounting into 168-pin edge connector sockets.

Synchronous design allows precise cycle control with the use of system clock. I/O transactions are possible on every clock cycle. Range of operating frequencies, programmable latencies allows the same device to be useful for a variety of high bandwidth, high performance memory system applications.

FEATURE

- Performance range

Part No.	Max Freq. (Speed)
KMM366S1623BT-G8	125MHz (8ns @ CL=3)
KMM366S1623BT-GH	100MHz (10ns @ CL=2)
KMM366S1623BT-GL	100MHz (10ns @ CL=3)

- Burst mode operation
- Auto & self refresh capability (4096 Cycles/64ms)
- LVTTL compatible inputs and outputs
- Single 3.3V ±0.3V power supply
- MRS cycle with address key programs
  Latency (Access from column address)
  Burst length (1, 2, 4, 8 & Full page)
  Data scramble (Sequential & Interleave)
- All inputs are sampled at the positive going edge of the system clock
- Serial presence detect with EEPROM
- PCB : **Height (1,375mil)**, double sided component

PIN CONFIGURATIONS (Front side/back side)

Pin	Front	Pin	Front	Pin	Front	Pin	Back	Pin	Back	Pin	Back
1	V_{SS}	29	DQM1	57	DQ18	85	V_{SS}	113	DQM5	141	DQ50
2	DQ0	30	$\overline{CS0}$	58	DQ19	86	DQ32	114	$\overline{CS1}$	142	DQ51
3	DQ1	31	DU	59	V_{DD}	87	DQ33	115	$\overline{RAS}$	143	V_{DD}
4	DQ2	32	V_{SS}	60	DQ20	88	DQ34	116	V_{SS}	144	DQ52
5	DQ3	33	A0	61	NC	89	DQ35	117	A1	145	NC
6	V_{DD}	34	A2	62	*V_{REF}	90	V_{DD}	118	A3	146	*V_{REF}
7	DQ4	35	A4	63	CKE1	91	DQ36	119	A5	147	NC
8	DQ5	36	A6	64	V_{SS}	92	DQ37	120	A7	148	V_{SS}
9	DQ6	37	A8	65	DQ21	93	DQ38	121	A9	149	DQ53
10	DQ7	38	A10/AP	66	DQ22	94	DQ39	122	BA0	150	DQ54
11	DQ8	39	BA1	67	DQ23	95	DQ40	123	A11	151	DQ55
12	V_{SS}	40	V_{DD}	68	V_{SS}	96	V_{SS}	124	V_{DD}	152	V_{SS}
13	DQ9	41	V_{DD}	69	DQ24	97	DQ41	125	CLK1	153	DQ56
14	DQ10	42	CLK0	70	DQ25	98	DQ42	126	*A12	154	DQ57
15	DQ11	43	V_{SS}	71	DQ26	99	DQ43	127	V_{SS}	155	DQ58
16	DQ12	44	DU	72	DQ27	100	DQ44	128	CKE0	156	DQ59
17	DQ13	45	$\overline{CS2}$	73	V_{DD}	101	DQ45	129	$\overline{CS3}$	157	V_{DD}
18	V_{DD}	46	DQM2	74	DQ28	102	V_{DD}	130	DQM6	158	DQ60
19	DQ14	47	DQM3	75	DQ29	103	DQ46	131	DQM7	159	DQ61
20	DQ15	48	DU	76	DQ30	104	DQ47	132	*A13	160	DQ62
21	*CB0	49	V_{DD}	77	DQ31	105	*CB4	133	V_{DD}	161	DQ63
22	*CB1	50	NC	78	V_{SS}	106	*CB5	134	NC	162	V_{SS}
23	V_{SS}	51	NC	79	CLK2	107	V_{SS}	135	NC	163	CLK3
24	NC	52	*CB2	80	NC	108	NC	136	*CB6	164	NC
25	NC	53	*CB3	81	WP	109	NC	137	*CB7	165	**SA0
26	V_{DD}	54	V_{SS}	82	**SDA	110	V_{DD}	138	V_{SS}	166	**SA1
27	$\overline{WE}$	55	DQ16	83	**SCL	111	$\overline{CAS}$	139	DQ48	167	**SA2
28	DQM0	56	DQ17	84	V_{DD}	112	DQM4	140	DQ49	168	V_{DD}

PIN NAMES

Pin Name	Function
A0 ~ A11	Address input (Multiplexed)
BA0 ~ BA1	Select bank
DQ0 ~ DQ63	Data input/output
CLK0 ~ CLK3	Clock input
CKE0 ~ CKE1	Clock enable input
$\overline{CS0}$ ~ $\overline{CS3}$	Chip select input
$\overline{RAS}$	Row address strobe
$\overline{CAS}$	Column address strobe
$\overline{WE}$	Write enable
DQM0 ~ 7	DQM
V_{DD}	Power supply (3.3V)
V_{SS}	Ground
*V_{REF}	Power supply for reference
SDA	Serial data I/O
SCL	Serial clock
SA0 ~ 2	Address in EEPROM
WP	Write protection
DU	Don t use
NC	No connection

* These pins are not used in this module.
** These pins should be NC in the system which does not support SPD.

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PIN CONFIGURATION DESCRIPTION

Pin	Name	Input Function
CLK	*System clock*	Active on the positive going edge to sample all inputs.
$\overline{CS}$	*Chip select*	Disables or enables device operation by masking or enabling all inputs except CLK, CKE and DQM.
CKE	*Clock enable*	Masks system clock to freeze operation from the next clock cycle. CKE should be enabled at least one cycle prior to new command. Disable input buffers for power down in standby. CKE should be enabled 1CLK+t_{SS} prior to valid command.
A0 ~ A11	*Address*	Row/column addresses are multiplexed on the same pins. Row address : RA0 ~ RA11, Column address : CA0 ~ CA8
BA0 ~ BA1	*Bank select address*	Selects bank to be activated during row address latch time. Selects bank for read/write during column address latch time.
$\overline{RAS}$	*Row address strobe*	Latches row addresses on the positive going edge of the CLK with $\overline{RAS}$ low. Enables row access & precharge.
$\overline{CAS}$	*Column address strobe*	Latches column addresses on the positive going edge of the CLK with $\overline{CAS}$ low. Enables column access.
$\overline{WE}$	*Write enable*	Enables write operation and row precharge. Latches data in starting from $\overline{CAS}$, $\overline{WE}$ active.
DQM0 ~ 7	*Data input/output mask*	Makes data output Hi-Z, t_{SHZ} after the clock and masks the output. Blocks data input when DQM active. (Byte masking)
DQ0 ~ 63	*Data input/output*	Data inputs/outputs are multiplexed on the same pins.
WP	*Write protection*	WP pin is connected to V_{SS} through 47K Ω Resistor. When WP is "high", EEPROM Programming will be inhibited and the entire memory will be write-protected.
V_{DD}/V_{SS}	*Power supply/ground*	Power and ground for the input buffers and the core logic.

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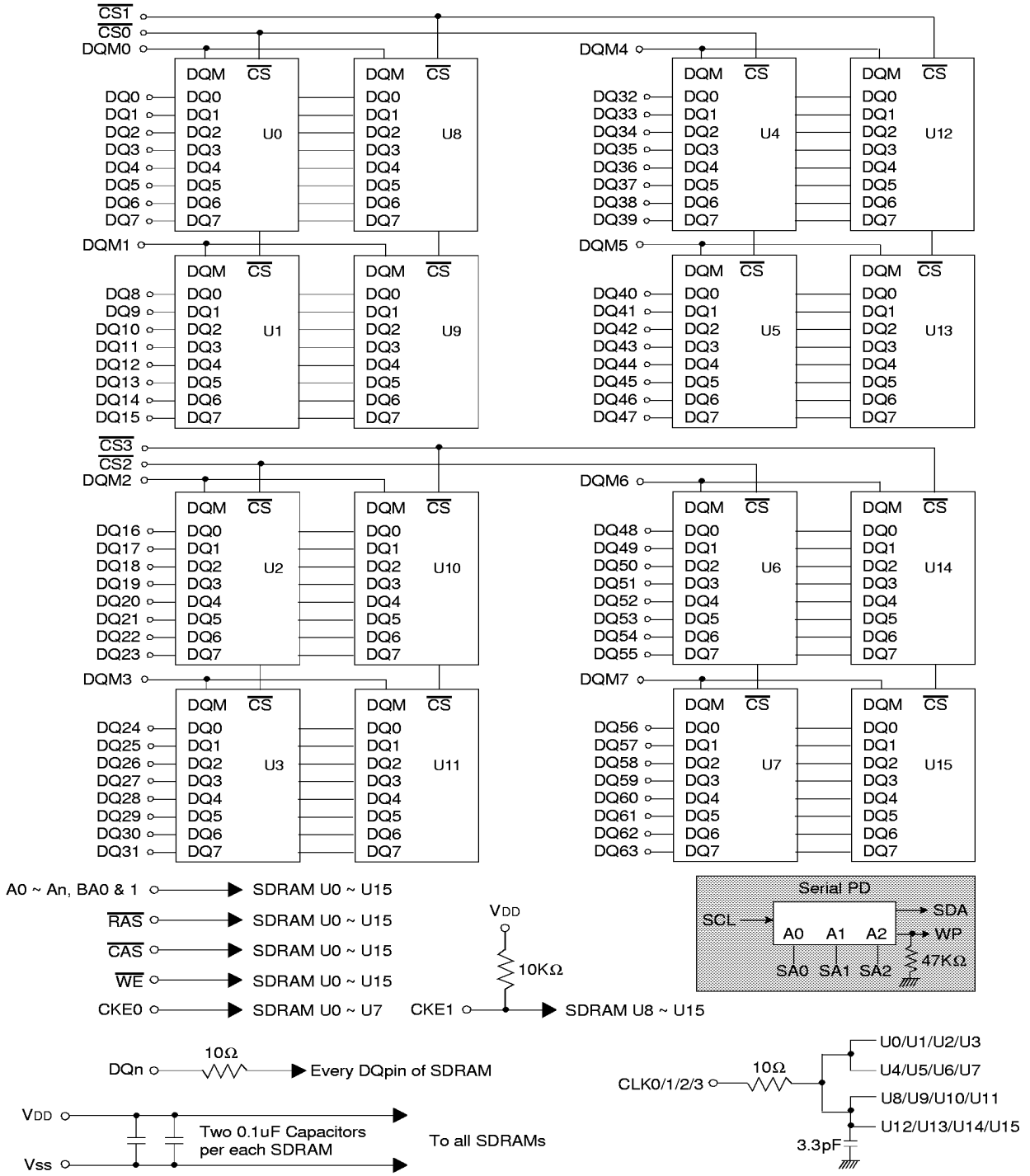
FUNCTIONAL BLOCK DIAGRAM



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ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Voltage on any pin relative to Vss	V_{IN}, V_{OUT}	-1.0 ~ 4.6	V
Voltage on V_{DD} supply relative to Vss	V_{DD}, V_{DDQ}	-1.0 ~ 4.6	V
Storage temperature	T_{STG}	-55 ~ +150	°C
Power dissipation	P_D	16	W
Short circuit current	I_{OS}	50	mA

Note : 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 could affect device reliability.

DC OPERATING CONDITIONS AND CHARACTERISTICS

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

Parameter	Symbol	Min	Typ	Max	Unit	Note
Supply voltage	V_{DD}, V_{DDQ}	3.0	3.3	3.6	V	
Input logic high voltage	V_{IH}	2.0	3.0	V_{DDQ}+0.3	V	1
Input logic low voltage	V_{IL}	-0.3	0	0.8	V	2
Output logic high voltage	V_{OH}	2.4	-	-	V	I_{OH} = -2mA
Output logic low voltage	V_{OL}	-	-	0.4	V	I_{OL} = 2mA
Input leakage current (Inputs)	I_{IL}	-16	-	16	uA	3
Input leakage current (I/O pins)	I_{IL}	-3	-	3	uA	3,4

Note : 1. V_{IH} (max) = 5.6V AC. The overshoot voltage duration is ≤ 3ns.
2. V_{IL} (min) = -2.0V AC. The undershoot voltage duration is ≤ 3ns.
3. Any input 0V ≤ V_{IN} ≤ V_{DDQ}.
Input leakage currents include Hi-Z output leakage for all bi-directional buffers with Tri-State outputs.
4. Dout is disabled, 0V ≤ V_{OUT} ≤ V_{DDQ}.

CAPACITANCE (V_{DD} = 3.3V, T_A = 23°C, f = 1MHz, V_{REF} = 1.4V ± 200 mV)

Pin	Symbol	Min	Max	Unit
Address (A0 ~ A11, BA0 ~ BA1)	C_{ADD}	60	90	pF
$\overline{RAS}$, $\overline{CAS}$, $\overline{WE}$	C_{IN}	60	90	pF
CKE (CKE0 ~ CKE1)	C_{CKE}	35	55	pF
Clock (CLK0 ~ CLK3)	C_{CLK}	25	35	pF
$\overline{CS}$ ($\overline{CS0}$, $\overline{CS2}$)	C_{CS}	25	35	pF
DQM (DQM0 ~ DQM7)	C_{DQM}	15	25	pF
DQ (DQ0 ~ DQ63)	C_{OUT}	10	20	pF

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DC CHARACTERISTICS

(Recommended operating condition unless otherwise noted, T_A = 0 to 70 °C)

Parameter	Symbol	Test Condition	CAS Latency	Version			Unit	Note
				-8	-H	-L		
Operating current (one Bank Active)	I_{CC1}	Burst length =1 $t_{RC} \geq t_{RC}$(min) I_{OL} = 0 mA		1,040	960	960	mA	1
Precharge standby current in power-down mode	$I_{CC2}P$	CKE ≤ V_{IL}(max), t_{CC} = 15ns		16			mA	
	$I_{CC2}PS$	CKE & CLK ≤ V_{IL}(max), t_{CC} = ∞		16				
Precharge standby current in non power-down mode	$I_{CC2}N$	CKE ≥ V_{IH}(min), $\overline{CS}$ ≥ V_{IH}(min), t_{CC} = 15ns Input signals are changed one time during 30ns		320			mA	
	$I_{CC2}NS$	CKE ≥ V_{IH}(min), CLK ≤ V_{IL}(max), t_{CC} = ∞ Input signals are stable		160				
Active standby current in power-down mode	$I_{CC3}P$	CKE ≤ V_{IL}(max), t_{CC} = 15ns		32			mA	
	$I_{CC3}PS$	CKE & CLK ≤ V_{IL}(max), t_{CC} = ∞		32				
Active standby current in non power-down mode (One bank active)	$I_{CC3}N$	CKE ≥ V_{IH}(min), $\overline{CS}$ ≥ V_{IH}(min), t_{CC} = 15ns Input signals are changed one time during 30ns		480			mA	
	$I_{CC3}NS$	CKE ≥ V_{IH}(min), CLK ≤ V_{IL}(max), t_{CC} = ∞ Input signals are stable		320			mA	
Operating current (Burst mode)	I_{CC4}	I_{OL} = 0 mA Page burst 2Banks activated t_{CCD} = 2CLKs	3	1,200	1,040	1,040	mA	1
			2	960	1,040	960		
Refresh current	I_{CC5}	$t_{RC} \geq t_{RC}$(min)		2,400			mA	2
Self refresh current	I_{CC6}	CKE ≤ 0.2V		16			mA	

Notes : 1. Measured with outputs open.
2. Refresh period is 64ms.

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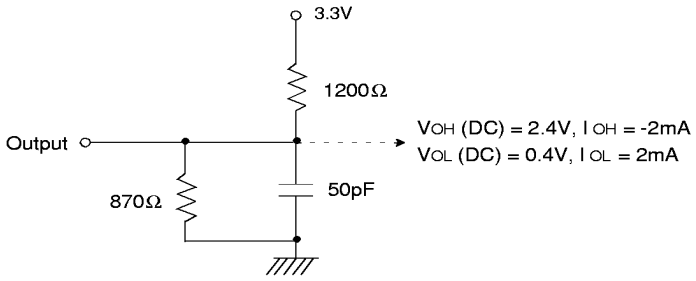
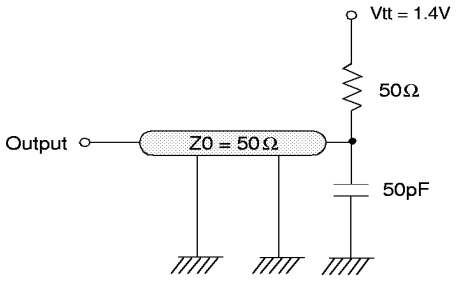
AC OPERATING TEST CONDITIONS (V_{DD} = 3.3V ± 0.3V, T_A = 0 to 70°C)

Parameter	Value	Unit
AC input levels (Vih/Vil)	2.4/0.4	V
Input timing measurement reference level	1.4	V
Input rise and fall time	tr/tf = 1/1	ns
Output timing measurement reference level	1.4	V
Output load condition	See Fig. 2	



(Fig. 1) DC output load circuit



(Fig. 2) AC output load circuit

OPERATING AC PARAMETER

(AC operating conditions unless otherwise noted)

Parameter		Symbol	Version			Unit	Note
			-8	-H	-L		
Row active to row active delay		t_{RRD}(min)	16	20	20	ns	1
$\overline{RAS}$ to $\overline{CAS}$ delay		t_{RCD}(min)	20	20	20	ns	1
Row precharge time		t_{RP}(min)	20	20	20	ns	1
Row active time		t_{RAS}(min)	48	50	50	ns	1
		t_{RAS}(max)	100			us	
Row cycle time		t_{RC}(min)	68	70	70	ns	1
Last data in to row precharge		t_{RDL}(min)	1			CLK	2
Last data in to new col. address delay		t_{CDL}(min)	1			CLK	2
Last data in to burst stop		t_{BDL}(min)	1			CLK	2
Col. address to col. address delay		t_{CCD}(min)	1			CLK	3
Number of valid output data	CAS latency=3		2			ea	4
	CAS latency=2		1				

Notes : 1. The minimum number of clock cycles is determined by dividing the minimum time required with clock cycle time and then rounding off to the next higher integer.
2. Minimum delay is required to complete write.
3. All parts allow every cycle column address change.
4. In case of row precharge interrupt, auto precharge and read burst stop.

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AC CHARACTERISTICS (AC operating conditions unless otherwise noted)

REFER TO THE INDIVIDUAL COMPONENET, NOT THE WHOLE MODULE.

Parameter		Symbol	-8		-H		-L		Unit	Note
			Min	Max	Min	Max	Min	Max		
CLK cycle time	CAS latency=3	t_{CC}	8	1000	10	1000	10	1000	ns	1
	CAS latency=2		12		10		12			
CLK to valid output delay	CAS latency=3	t_{SAC}		6		6		6	ns	1,2
	CAS latency=2			6		6		7		
Output data hold time	CAS latency=3	t_{OH}	3		3		3		ns	2
	CAS latency=2		3		3		3			
CLK high pulse width		t_{CH}	3		3		3		ns	3
CLK low pulse width		t_{CL}	3		3		3		ns	3
Input setup time		t_{SS}	2		2		2		ns	3
Input hold time		t_{SH}	1		1		1		ns	3
CLK to output in Low-Z		t_{SLZ}	1		1		1		ns	2
CLK to output in Hi-Z	CAS latency=3	t_{SHZ}		6		6		6	ns	
	CAS latency=2			6		6		7		

Notes : 1. Parameters depend on programmed CAS latency.

2. If clock rising time is longer than 1ns, (tr/2-0.5)ns should be added to the parameter.

3. Assumed input rise and fall time (tr & tf) = 1ns.
   If tr & tf is longer than 1ns, transient time compensation should be considered,
   i.e., [(tr + tf)/2-1]ns should be added to the parameter.

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FREQUENCY vs. AC PARAMETER RELATIONSHIP TABLE

KMM366S1623BT- G8

(Unit : Number of clock)

Frequency	CAS Latency	tRC	tRAS	tRP	tRRD	tRCD	tCCD	tCDL	tRDL
		68ns	48ns	20ns	16ns	20ns	8ns	8ns	8ns
125MHz (8.0ns)	3	9	6	3	2	3	1	1	1
100MHz (10.0ns)	3	7	5	2	2	2	1	1	1
83MHz (12.0ns)	2	6	4	2	2	2	1	1	1
75MHz (13.0ns)	2	6	4	2	2	2	1	1	1
66MHz (15.0ns)	2	5	4	2	2	2	1	1	1

KMM366S1623BT- GH

(Unit : Number of clock)

Frequency	CAS Latency	tRC	tRAS	tRP	tRRD	tRCD	tCCD	tCDL	tRDL
		70ns	50ns	20ns	20ns	20ns	10ns	10ns	10ns
100MHz (10.0ns)	2	7	5	2	2	2	1	1	1
83MHz (12.0ns)	2	6	5	2	2	2	1	1	1
75MHz (13.0ns)	2	6	4	2	2	2	1	1	1
66MHz (15.0ns)	2	5	4	2	2	2	1	1	1
60MHz (16.7ns)	2	5	3	2	2	2	1	1	1

KMM366S1623BT- GL

(Unit : Number of clock)

Frequency	CAS Latency	tRC	tRAS	tRP	tRRD	tRCD	tCCD	tCDL	tRDL
		70ns	50ns	20ns	20ns	20ns	10ns	10ns	10ns
100MHz (10.0ns)	3	7	5	2	2	2	1	1	1
83MHz (12.0ns)	2	6	5	2	2	2	1	1	1
75MHz (13.0ns)	2	6	4	2	2	2	1	1	1
66MHz (15.0ns)	2	5	4	2	2	2	1	1	1
60MHz (16.7ns)	2	5	3	2	2	2	1	1	1

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SIMPLIFIED TRUTH TABLE

Command			CKEn-1	CKEn	$\overline{CS}$	$\overline{RAS}$	$\overline{CAS}$	$\overline{WE}$	DQM	$BA_{0,1}$	A_{10}/AP	A_{11}, $A_9 \sim A_0$	Note
Register	Mode register set		H	X	L	L	L	L	X	OP code			1,2
Refresh	Auto refresh		H	H	L	L	L	H	X	X			3
	Self refresh	Entry		L									3
		Exit	L	H	L	H	H	H	X	X			3
					H	X	X	X					3
Bank active & row addr.			H	X	L	L	H	H	X	V	Row address		
Read & column address	Auto precharge disable		H	X	L	H	L	H	X	V	L	Column address ($A_0 \sim A_8$)	4
	Auto precharge enable										H		4,5
Write & column address	Auto precharge disable		H	X	L	H	L	L	X	V	L	Column address ($A_0 \sim A_8$)	4
	Auto precharge enable										H		4,5
Burst stop			H	X	L	H	H	L	X	X			6
Precharge	Bank selection		H	X	L	L	H	L	X	V	L	X	
	All banks									X	H		
Clock suspend or active power down		Entry	H	L	H	X	X	X	X	X			
					L	V	V	V					
		Exit	L	H	X	X	X	X	X				
Precharge power down mode		Entry	H	L	H	X	X	X	X	X			
					L	H	H	H					
		Exit	L	H	H	X	X	X	X				
					L	V	V	V					
DQM			H	X					V	X			7
No operation command			H	X	H	X	X	X	X	X			
					L	H	H	H					

(V=Valid, X=Don t care, H=Logic high, L=Logic low)

Notes : 1. OP Code : Operand code
$A_0 \sim A_{11}$ & $BA_0 \sim BA_1$: Program keys. (@ MRS)
2. MRS can be issued only at all banks precharge state.
A new command can be issued after 2 clock cycles of MRS.
3. Auto refresh functions are as same as CBR refresh of DRAM.
The automatical precharge without row precharge command is meant by "Auto".
Auto/self refresh can be issued only at all banks precharge state.
4. $BA_0 \sim BA_1$: Bank select addresses.
If both BA_0 and BA_1 are "Low" at read, write, row active and precharge, bank A is selected.
If both BA_0 is "Low" and BA_1 is "High" at read, write, row active and precharge, bank B is selected.
If both BA_0 is "High" and BA_1 is "Low" at read, write, row active and precharge, bank C is selected.
If both BA_0 and BA_1 are "High" at read, write, row active and precharge, bank D is selected.
If A_{10}/AP is "High" at row precharge, BA_0 and BA_1 is ignored and all banks are selected.
5. During burst read or write with auto precharge, new read/write command can not be issued.
Another bank read/write command can be issued after the end of burst.
New row active of the associated bank can be issued at t_{RP} after the end of burst.
6. Burst stop command is valid at every burst length.
7. DQM sampled at positive going edge of a CLK and masks the data-in at the very CLK (Write DQM latency is 0), but makes Hi-Z state the data-out of 2 CLK cycles after. (Read DQM latency is 2)

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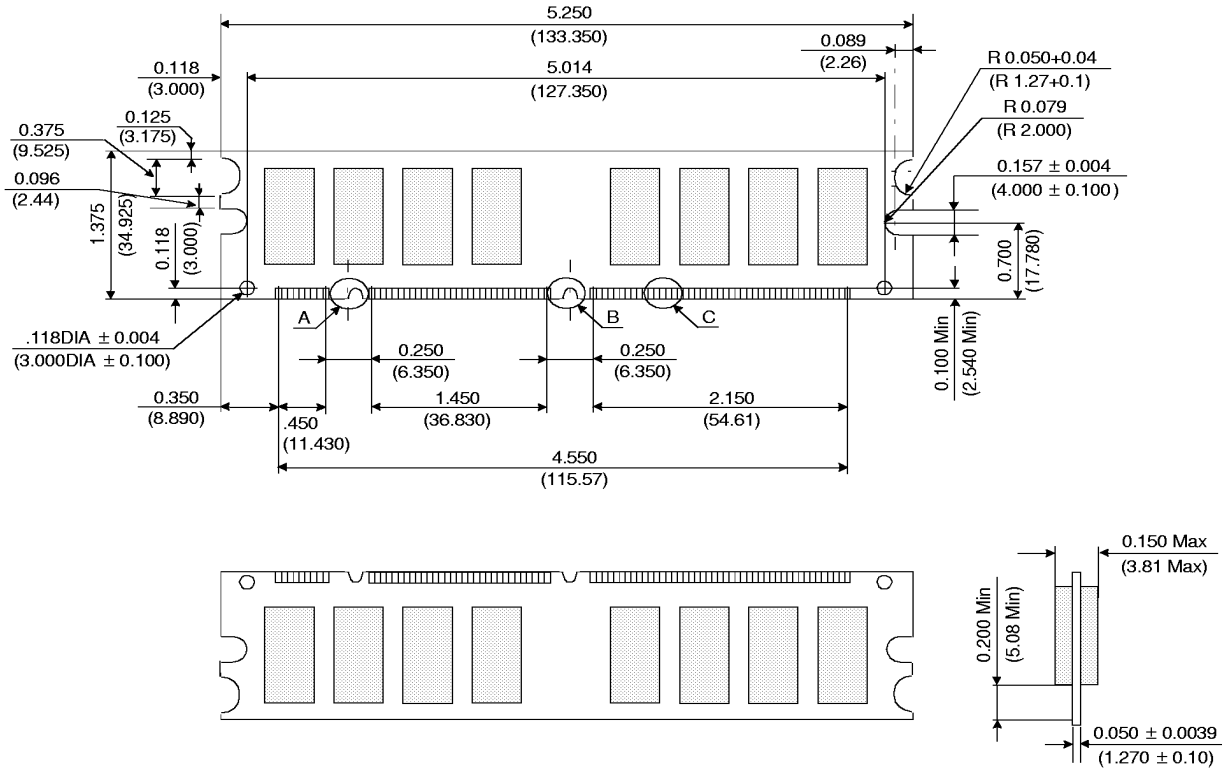
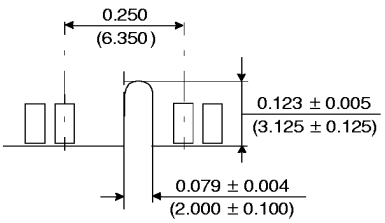
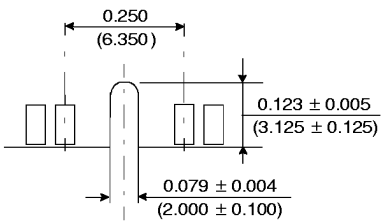
PACKAGE DIMENSIONS

Units : Inches (Millimeters)





Detail A



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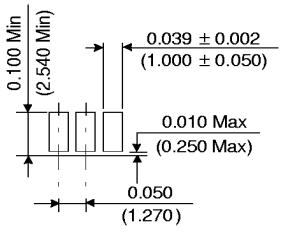

Detail C

Tolerances : ± 0.005(.13) unless otherwise specified

The used device is 8Mx8 SDRAM, TSOP
SDRAM Part No. : KM48S8030BT

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