Synchronous DRAM Module 1024Mbyte (128Mx72Bit), 8K Ref., 3.3V

ECC Unbuffered SO-DIMM, Part No. HSD128M72B9K

GENERAL DESCRIPTION

The HSD128M72B9K is a 128M x 72 bit Synchronous Dynamic RAM high density memory module. The module consists of nine CMOS 128M x 8 bit with 4banks Synchronous DRAMs in TSOP-II 400mil packages on a 144-pin glass-epoxy substrate. One or two 0.1uF decoupling capacitors are mounted on the printed circuit board in parallel for each SDRAM. The HSD128M72B9K is a SO-DIMM(Small Outline Dual in line Memory Module) and is intended for mounting into 144-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 All module components may be powered from a single 3.3V DC power supply and all inputs and outputs are LVTTL-compatible.

FEATURES

• JEDEC standard 3.3V power supply
• Burst mode operation
• Auto & self refresh capability (8192 Cycles/64ms)
• LVTTL compatible with multiplexed address
• Separate power and ground planes to improve immunity
• Height : 1.250 inches

• MRS cycle with address key programs
  - CAS latency (2 & 3)
  - 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
• The used device is 16M x 8bit x 4Banks Synchronous DRAM

• Part Identification

HSD128M72B9K-F/10L : 100MHz (CL=3)
HSD128M72B9K-F/10 : 100MHz (CL=2)
HSD128M72B9K-F/12 : 125MHz (CL=3)
HSD128M72B9K-F/13 : 133MHz (CL=3)

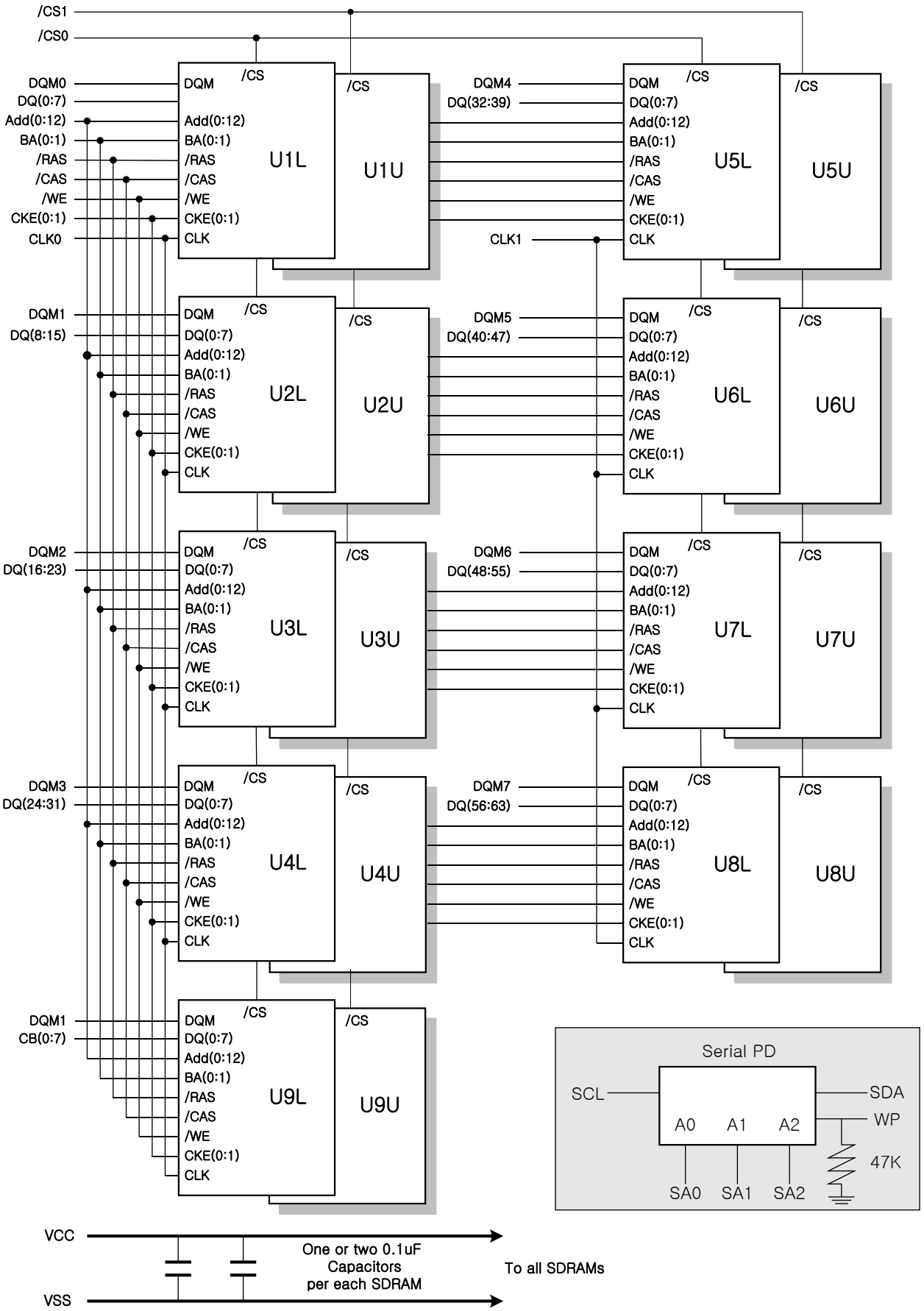
** F means Auto & Self refresh with Low-Power (3.3V)

PIN ASSIGNMENT

No.	Front	No.	Back	No.	Front	No.	Back
1	Vss	2	Vss	71	/CS1	72	NC
3	DQ0	4	DQ32	73	NC	74	CLK1
5	DQ1	6	DQ33	75	Vss	76	Vss
7	DQ2	8	DQ34	77	CB2	78	CB6
9	DQ3	10	DQ35	79	CB3	80	CB7
11	VCC	12	VCC	81	VCC	82	VCC
13	DQ4	14	DQ36	83	DQ16	84	DQ48
15	DQ5	16	DQ37	85	DQ17	86	DQ49
`17	DQ6	18	DQ38	87	DQ18	88	DQ50
19	DQ7	20	DQ39	89	DQ19	90	DQ51
21	Vss	22	Vss	91	Vss	92	Vss
23	DQM0	24	DQM4	93	DQ20	94	DQ52
25	DQM1	26	DQM5	95	DQ21	96	DQ53
27	VCC	28	VCC	97	DQ22	98	DQ54
29	A0	30	A3	99	DQ23	100	DQ55
31	A1	32	A4	101	VCC	102	VCC
33	A2	34	A5	103	A6	104	A7
35	Vss	36	Vss	105	A8	106	BA0
37	DQ8	38	DQ40	107	Vss	108	Vss
39	DQ9	40	DQ41	109	A9	110	BA1
41	DQ10	42	DQ42	111	A10_AP	112	A11
43	DQ11	44	DQ43	113	VCC	114	VCC
45	VCC	46	VCC	115	DQM2	116	DQM6
47	DQ12	48	DQ44	117	DQM3	118	DQM7
49	DQ13	50	DQ45	119	Vss	120	Vss
51	DQ14	52	DQ46	121	DQ24	122	DQ56
53	DQ15	54	DQ47	123	DQ25	124	DQ57
55	Vss	56	Vss	125	DQ26	126	DQ58
57	CB0	58	CB4	127	DQ27	128	DQ59
59	CB1	60	CB5	129	VCC	130	VCC
Voltage Key				131	DQ28	132	DQ60
				133	DQ29	134	DQ61
61	CLK0	62	CKE0	135	DQ30	136	DQ62
63	VCC	64	VCC	137	DQ31	138	DQ63
65	/RAS	66	/CAS	139	Vss	140	Vss
67	/WE	68	CKE1	141	**SDA	142	**SCL
69	/CS0	70	A12	143	VCC	144	VCC

** These pins should be NC in the system which does not support SPD

Functional Block Diagram



PIN FUNCTION DESCRIPTION

Pin	Name	Input Function
CLK0~CLK1	System clock	Active on the positive going edge to sample all inputs.
/CS0~/CS1	Chip select	Disables or enables device operation by masking or enabling all inputs except CLK, CKE and DQM
CKE0, CKE1	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+tSS prior to valid command.
A0 ~ A12	Address	Row/column addresses are multiplexed on the same pins. Row address : RA0 ~ RA12, Column address : CA0 ~ CA9, CA11
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.
/RAS	Row address strobe	Latches row addresses on the positive going edge of the CLK with /RAS low. Enables row access & precharge.
/CAS	Column address strobe	Latches column addresses on the positive going edge of the CLK with /CAS low. Enables column access.
/WE	Write enable	Enables write operation and row precharge. Latches data in starting from /CAS, /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.
CB0~7	Check bit	Check bits for ECC
V_{CC} / V_{SS}	Power supply / ground	Power and ground for the input buffers and the core logic.

ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING
Voltage on Any Pin Relative to Vss	V_{IN} , V_{OUT}	-1V to 4.6V
Voltage on Vcc Supply Relative to Vss	Vcc	-1V to 4.6V
Power Dissipation	P_D	18W
Storage Temperature	T_{STG}	-55^{o}C to 150^{o}C
Short Circuit Output Current	I_{OS}	50mA

Notes:

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.

DC OPERATING CONDITIONS

(Recommended operating conditions (Voltage referenced to VSS = 0V, TA = 0 to 70°C))

PARAMETER	SYMBOL	MIN	TYP.	MAX	UNIT	NOTE
Supply Voltage	Vcc	3.0	3.3	3.6	V	
Input High Voltage	V_{IH}	2.0	3.0	Vcc+0.3	V	1
Input Low Voltage	V_{IL}	-0.3	0	0.8	V	2
Output High Voltage	V_{OH}	2.4	-	-	V	I_{OH} = -2mA
Output Low Voltage	V_{OL}	-	-	0.4	V	I_{OL} = 2mA
Input leakage current	I_{LI}	-10	-	10	uA	3

Notes :

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.

CAPACITANCE

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

PARAMETER	SYMBOL	MIN	MAX	UNITS
Input Capacitance (A0~A12, BA0~BA1)	C_{IN1}	45	90	pF
Input Capacitance (/RAS, /CAS, /WE)	C_{IN2}	45	90	pF
Input Capacitance (CKE0 ~ CKE1)	C_{IN3}	35	60	pF
Input Capacitance (CLK0 ~ CLK1)	C_{IN4}	25	45	pF
Input Capacitance (/CS0 ~ /CS1)	C_{IN5}	35	60	pF
Input Capacitance (DQM0 ~ DQM1)	C_{IN6}	10	25	pF
Data Input Capacitance (DQ0 ~ DQ63)	C_{IN7}	15	30	pF
Data Input Capacitance (CB0 ~ CB7)	C_{OUT}	15	30	pF

DC CHARACTERISTICS

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

PARAMETER	SYMBOL	TEST CONDITION	VERSION				UNIT	NOTE
			-13	-12	-10	-10L		
Operating current (One bank active)	I_{CC1}	Burst length = 1 $t_{RC} \geq t_{RC}$(min) I_O = 0mA	1080	990	990	990	mA	1
Precharge standby current in power-down mode	$I_{CC2}P$	CKE ≤ V_{IL}(max) t_{CC}=10ns	36				mA	
	$I_{CC2}PS$	CKE & CLK ≤ V_{IL}(max) t_{CC}=∞	36				mA	
Precharge standby current in non power-down mode	$I_{CC2}N$	CKE ≥ V_{IH}(min) CS* ≥ V_{IH}(min), t_{CC}=10ns Input signals are changed one time during 20ns	360				mA	

	$I_{CC2}NS$	CKE ≥ V_{IH}(min) CLK ≤ V_{IL}(max), t_{CC}=∞ Input signals are stable	180					
Active standby current in power-down mode	$I_{CC3}P$	CKE ≤ V_{IL}(max), t_{CC}=10ns	72				mA	
	$I_{CC3}PS$	CKE&CLK ≤ V_{IL}(max) t_{CC}=∞	72				mA	
Active standby current in non power-down mode (One bank active)	$I_{CC3}N$	CKE≥V_{IH}(min), CS*≥V_{IH}(min), t_{CC}=10ns Input signals are changed one time during 20ns	450				mA	
	$I_{CC3}NS$	CKE≥VIH(min) CLK ≤VIL(max), t_{CC}=∞ Input signals are stable	315				mA	
Operating current (Burst mode)	I_{CC4}	I_O = 0 mA Page burst 4Banks Activated t_{CCD} = 2CLKs	1260	1260	1170	1170	mA	1
Refresh current	I_{CC5}	t_{RC} ≥ t_{RC}(min)	2160	1980	1890	1890	mA	2
Self refresh current	I_{CC6}	CKE ≤ 0.2V	54				mA	3
			27				mA	4

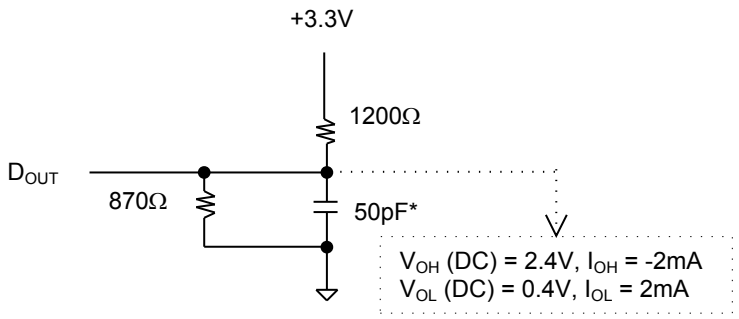
Notes :

1. Measured with outputs open.
2. Refresh period is 64ms.
3. Unless otherwise noticed, input swing level is CMOS(V_{IH}/V_{IL}=V_{DDQ}/V_{SSQ}).

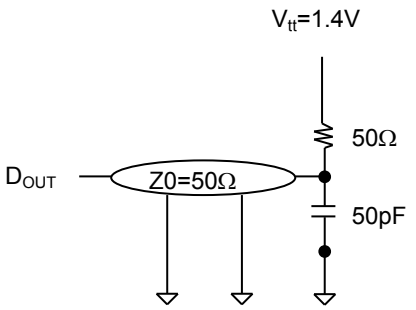
AC OPERATING TEST CONDITIONS

(Vcc = 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



(Fig. 2) AC output load circuit

OPERATING AC PARAMETER

(AC operating conditions unless otherwise noted)

PARAMETER		SYMBOL	VERSION				UNIT	NOTE
			-13	-12	-10	-10L		
Row active to row active delay		t_{RRD}(min)	15	16	20	20	ns	1
RAS to CAS delay		t_{RP}(min)	20	20	20	20	ns	1
Row precharge time		t_{RP}(min)	20	20	20	20	ns	1
Row active time		t_{RAS}(min)	45	48	50	50	ns	1
		t_{RAS}(max)	100				ns	
Row cycle time		$_{tRC}$(min)	65	68	70	70	ns	1
Last data in to row precharge		t_{RDL}(min)	2				CLK	2.5
Last data in to Active delay		t_{DAL}(min)	2 CLK + t_{RP}				-	5
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.
5. For -8/H/L, t_{RDL}=1CLK and t_{DAL}=1CLK+20ns is also supported .
   (Recommand : t_{RDL}=2CLK and t_{DAL}=2CLK & 20ns.)

AC CHARACTERISTICS

(AC operating conditions unless otherwise noted)

PARAMETER		SYMBOL	-13		-12		-10		-10L		UNIT	NOTE
			MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX		
CLK cycle time	CAS latency=3	t_{CC}	7.5	1000	8	1000	10	1000	10	1000	ns	1
	CAS latency=2		-		-		10		12			
CLK to valid output delay	CAS latency=3	t_{SAC}		5.4		6		6		6	ns	1,2
	CAS latency=2			-		-		6		7		
Output data hold time	CAS latency=3	t_{OH}	2.7		3		3		3		ns	2

	CAS latency=2		-		-		3		3			
CLK high pulse width		t_{CH}	2.5		3		3		3		ns	3
CLK low pulse width		t_{CL}	2.5		3		3		3		ns	3
Input setup time		t_{SS}	1.5		2		2		2		ns	3
Input hold time		t_{SH}	0.8		1		1		1		ns	3
CLK to output in Low-Z		t_{SLZ}	1		1		1		1		ns	3
CLK to output in Hi-Z	CAS latency=3	t_{SHZ}		5.4		6		6		6	ns	2
	CAS latency=2			-		-		6		7	ns	

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, ie., [(tr + tf)/2-1]ns should be added to the parameter.

SIMPLIFIED TRUTH TABLE

COMMAND			CKE n-1	CKE n	/CS	/RAS	/CAS	/WE	DQM	BA0,1	A10/AP	A11,A12, A9~A0	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 (A0 ~ A9)	4
	Auto precharge disable										H		4,5
Write & column address	Auto precharge disable		H	X	L	H	L	L	X	V	L	Column Address (A0 ~ A9)	4
	Auto precharge disable										H		4,5
Burst Stop			H	X	L	L	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			

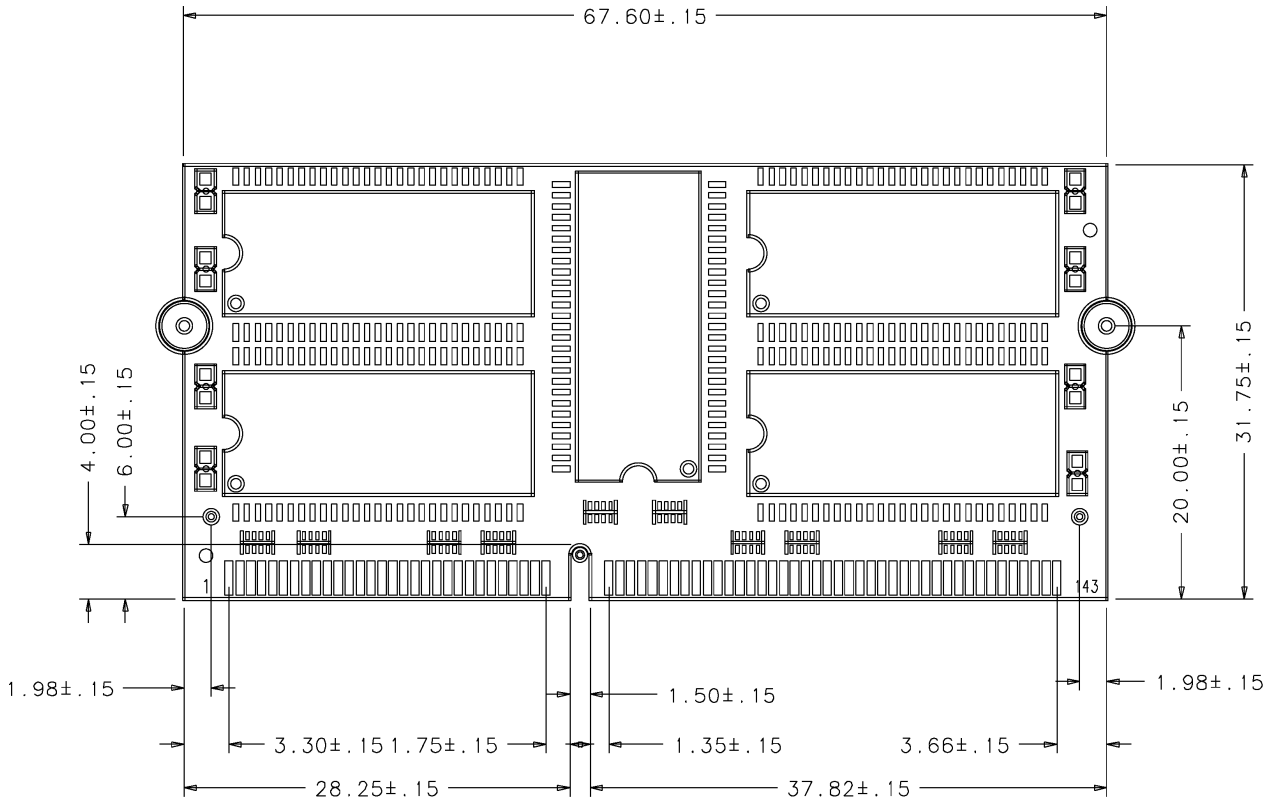
(V=Valid, X=Don't care, H=Logic high, L=Logic low)

Notes :

1. OP Code : Operand code
   A0 ~ A12 & BA0 ~ BA1 : Program keys. (@ MRS)
2. MRS can be issued only at all banks precharge state.
   A new command can be issued after 2 CLK 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. BA0 ~ BA1 : Bank select addresses.
   If both BA0 and BA1 are "Low" at read, write, row active and precharge, bank A is selected.
   If both BA0 is "Low" and BA1 is "High" at read, write, row active and precharge, bank B is selected.
   If both BA0 is "High" and BA1 is "Low" at read, write, row active and precharge, bank C is selected.
   If both BA0 and BA1 are "High" at read, write, row active and precharge, bank D is selected.
   If A10/AP is "High" at row precharge, BA0 and BA1 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 tRP 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)

PACKAGING INFORMATION

Unit : mm



PCB Thickness: 1.0±0.1mm

Tolerances : ± 0.15 unless otherwise specified

Immersion Gold PCB Pattern

ORDERING INFORMATION

Part Number	Density	Org.	Package	Ref.	Vcc	Bank	MAX.frq
HSD128M72B9K-13	1024MByte	128M x 72	144 Pin-SODIMM	8K	3.3V	4Bank	CL3 133MHz
HSD128M72B9K-12	1024MByte	128M x 72	144 Pin-SODIMM	8K	3.3V	4Bank	CL3 125MHz
HSD128M72B9K-10L	1024MByte	128M x 72	144 Pin-SODIMM	8K	3.3V	4Bank	CL3 100MHz
HSD128M72B9K-10	1024MByte	128M x 72	144 Pin-SODIMM	8K	3.3V	4Bank	CL2 100MHz
HSD128M72B9K-F13	1024MByte	128M x 72	144 Pin-SODIMM	8K	3.3V	4Bank	CL3 133MHz
HSD128M72B9K-F12	1024MByte	128M x 72	144 Pin-SODIMM	8K	3.3V	4Bank	CL3 125MHz
HSD128M72B9K-F10L	1024MByte	128M x 72	144 Pin-SODIMM	8K	3.3V	4Bank	CL3 100MHz
HSD128M72B9K-F10	1024MByte	128M x 72	144 Pin-SODIMM	8K	3.3V	4Bank	CL2 100MHz

F means Auto & Self refresh with Low-Power (3.3V)