



**Synchronous DRAM Module 32Mbyte (8M x 32-Bit) 144pin SO-DIMM based on
4Mx16, 4Banks, 4K Ref., 3.3V**

Part No. HSD8M32B4

GENERAL DESCRIPTION

The HSD8M32B4 is a 8M x 32 bit Synchronous Dynamic RAM high density memory module. The module consists of four CMOS 1M x 16 bit x 4banks Synchronous DRAMs in TSOP-II packages mounted on a 144-pin, FR-4-printed circuit board. Two 0.01uF decoupling capacitor is mounted on the printed circuit board in parallel for each SDRAM. The HSD8M32B4 is a SO-DIMM designed. 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 LVTTTL-compatible.

FEATURES

• Part Identification

HSD8M32B4-10 : 100MHz (CL=2)

HSD8M32B4-10L : 100MHz (CL=3)

HSD8M32B4-12 : 125MHz (CL=3)

HSD8M32B4-13 :133MHz (CL=3)

- Burst mode operation
- Auto & self refresh capability (4096 Cycles/64ms)
- LVTTTL compatible inputs and outputs
- Single 3.3V \pm 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
- FR4-PCB design
- The used device is K4S641632D-TC

PIN ASSIGNMENT

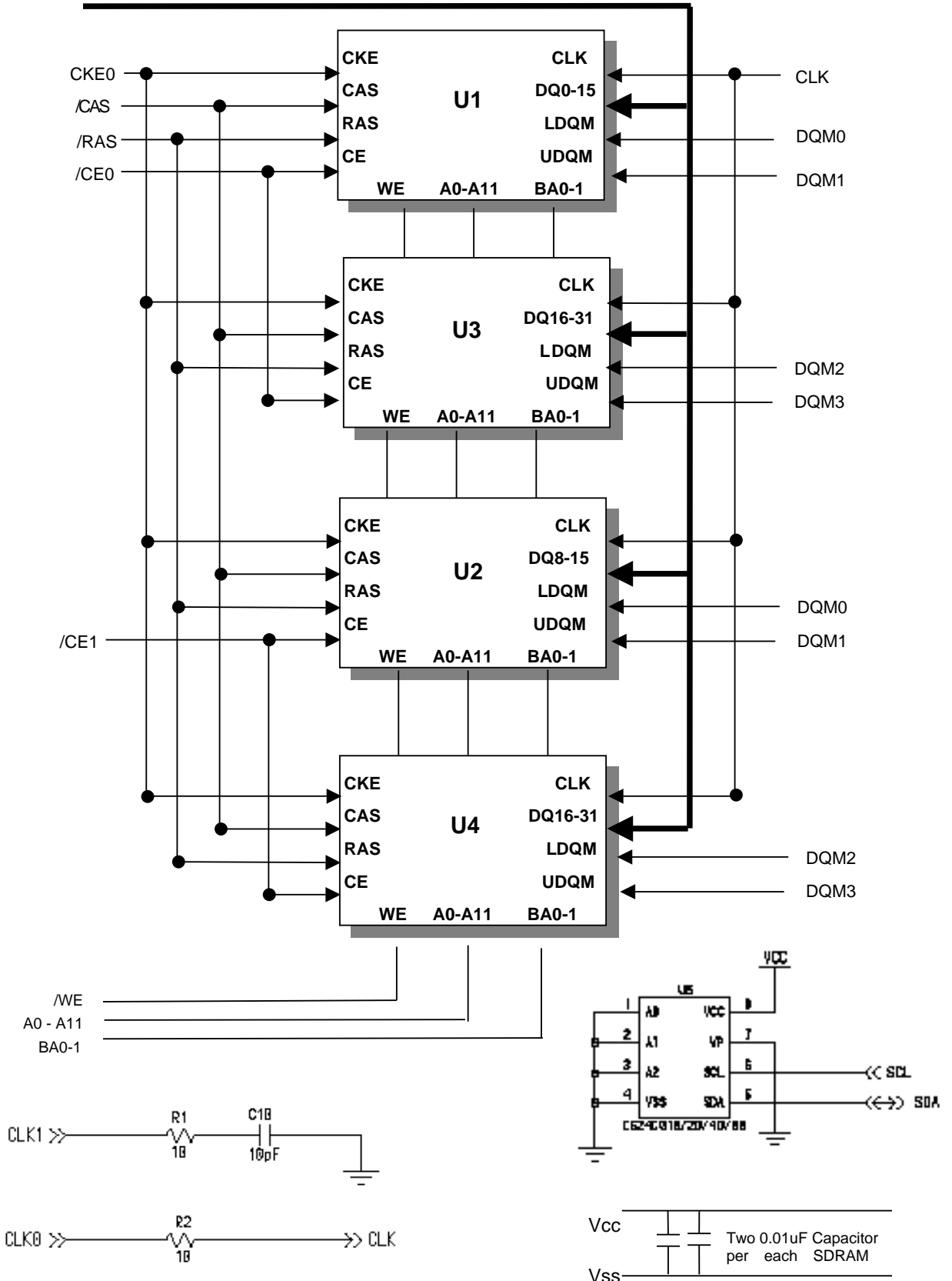
PIN	Front	PIN	Back	PIN	Frontl	PIN	Back	PIN	Front	PIN	Back
1	Vss	2	Vss	49	DQ13	50	NC	97	DQ22	98	NC
3	DQ0	4	NC	51	DQ14	52	NC	99	DQ23	100	NC
5	DQ1	6	NC	53	DQ15	54	NC	101	VCC	102	VCC
7	DQ2	8	NC	55	Vss	56	Vss	103	A6	104	A7
9	DQ3	10	NC	57	NC	58	NC	105	A8	106	BA0
11	VCC	12	VCC	59	NC	60	NC	107	Vss	108	Vss
13	DQ4	14	NC	61	CLK0	62	CKE0	109	A9	110	BA1
15	DQ4	16	NC	63	VCC	64	VCC	111	A10	112	A11
17	DQ6	18	NC	65	/RAS	66	/CAS	113	VCC	114	VCC
19	DQ7	20	NC	67	/WE	68	NC	115	DQM2	116	NC
21	Vss	22	Vss	69	/CS0	70	NC	117	DQM3	118	NC
23	DQM0	24	NC	71	/CS1	72	NC	119	Vss	120	Vss
25	DQM1	26	NC	73	DU	74	CLK1	121	DQ24	122	NC
27	VCC	28	VCC	75	Vss	76	Vss	123	DQ25	124	NC
29	A0	30	A3	77	NC	78	NC	125	DQ26	126	NC
31	A1	32	A4	79	NC	80	NC	127	DQ27	128	NC
33	A2	34	A5	81	VCC	82	VCC	129	VCC	130	VCC
35	Vss	36	Vss	83	DQ16	84	NC	131	DQ28	132	NC
37	DQ8	38	NC	85	DQ17	86	NC	133	DQ29	134	NC
39	DQ9	40	NC	87	DQ18	88	NC	135	DQ30	136	NC
41	DQ10	42	NC	89	DQ19	90	NC	137	DQ31	138	NC
43	DQ11	44	NC	91	Vss	92	Vss	139	Vss	140	Vss
45	VCC	46	VCC	93	DQ20	94	NC	141	SDA	142	SCL
47	DQ12	48	NC	95	DQ21	96	NC	143	VCC	144	VCC

*Pin Names

Pin Name	Function	Pin Name	Function
A0 ~ A11	Address input (Multiplexed)	BA0 ~ BA1	Select bank
DQ0 ~ DQ31	Data input/output	CLK0,CLK1	Clock input
CKE0	Clock enable input	/CS0, /CS1	Chip select input
/RAS	Row address strobe	CAS	Column address strobe
/WE	Write enable	DQM0 ~ 3	DQM
Vcc	Power supply (3.3V)	Vss	Ground
SDA	Serial data I/O	SCL	Serial clock
DU	Do not use	NC	No connection

FUNCTIONAL BLOCK DIAGRAM

DQ0-31



PIN FUNCTION DESCRIPTION

Pin	Name	Input Function
CLK	System clock	Active on the positive going edge to sample all inputs.
/CE	Chip enable	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+tSS 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.
/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 ~ 3	Data input/output mask	Makes data output Hi-Z, tSHZ after the clock and masks the output. Blocks data input when DQM active. (Byte masking)
DQ0 ~ 31	Data input/output	Data inputs/outputs are multiplexed on the same pins.
VDD/VSS	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_OUT}	-1V to 4.6V
Voltage on Vcc Supply Relative to Vss	VCC	-1V to 4.6V
Power Dissipation	P_D	4W
Storage Temperature	T_{STG}	-55°C to 150°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 $V_{SS} = 0V$, $T_A = 0$ to $70^\circ C$))

PARAMETER	SYMBOL	MIN	TYP.	MAX	UNIT	NOTE
Supply Voltage	V_{CC}	3.0	3.3	3.6	V	
Input High Voltage	V_{IH}	2.0	3.0	$V_{CC}+0.3$	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	μA	3

Notes :

- V_{IH} (max) = 5.6V AC. The overshoot voltage duration is $\leq 3ns$.
- V_{IL} (min) = -2.0V AC. The undershoot voltage duration is $\leq 3ns$.
- Any input $0V \leq V_{IN} \leq V_{DDQ}$.
Input leakage currents include Hi-Z output leakage for all bi-directional buffers with Tri-State outputs.

CAPACITANCE

($V_{CC} = 3.3V$, $T_A = 23^\circ C$, $f = 1MHz$, $V_{REF} = 1.4V \pm 200 mV$)

DESCRIPTION	SYMBOL	MIN	MAX	UNIT	NOTE
Address(A0~A11, BA0~BA1)	C_{ADD}	10	20	pF	2
/RAS, /CAS, /WE	C_{IN}	10	20	pF	2
CKE(CKE0)	C_{CKE}	10	20	pF	2
Clock (CLK0)	C_{CLK}	10	16	pF	1
/CE (/CE1)	C_{CS}	10	20	pF	2
DQM (DQM0 ~ DQM3)	C_{DQM}	10	20	pF	2
DQ (DQ0 ~ DQ31)	C_{OUT}	16	26	pF	3

Notes :

- 13 only specify a maximum value of 3.5pF
- 13 only specify a maximum value of 3.8pF
- 13 only specify a maximum value of 6.0pF

DC CHARACTERISTICS

(Recommended operating condition unless otherwise noted, $T_A = 0$ to $70^\circ C$)

PARAMETER	SYMBOL	TEST CONDITION	VERSION				UNIT	NOTE
			-13	-12	-10	-10L		
Operating current (One bank active)	I_{CC1}	Burst length = 1 $t_{RC} \geq t_{RC}(\min)$ $I_O = 0mA$	440	440	400	400	mA	1
Precharge standby current in power-down mode	I_{CC2P}	$CKE \leq V_{IL}(\max)$ $t_{CC} = 10ns$	4				mA	
	I_{CC2PS}	$CKE \& CLK \leq V_{IL}(\max)$ $t_{CC} = \infty$	4				mA	

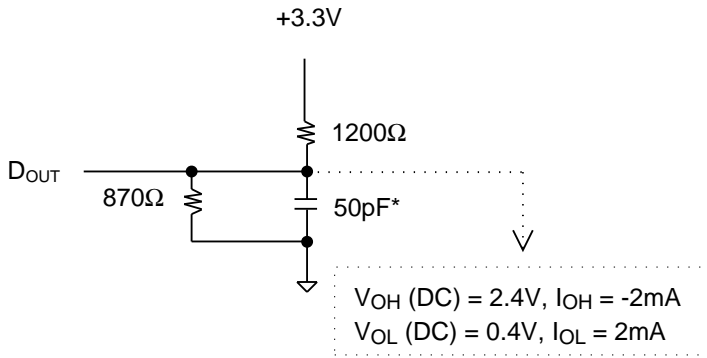
Precharge standby current in non power-down mode	I_{CC2N}	CKE $\geq V_{IH}(\min)$ CS* $\geq V_{IH}(\min)$, $t_{CC}=10\text{ns}$ Input signals are changed one time during 20ns	60				mA	
	I_{CC2NS}	CKE $\geq V_{IH}(\min)$ CLK $\leq V_{IL}(\max)$, $t_{CC}=\infty$ Input signals are stable	24					
Active standby current in power-down mode	I_{CC3P}	CKE $\leq V_{IL}(\max)$, $t_{CC}=10\text{ns}$	12				mA	
	I_{CC3PS}	CKE&CLK $\leq V_{IL}(\max)$ $t_{CC}=\infty$	12					
Active standby current in non power-down mode (One bank active)	I_{CC3N}	CKE $\geq V_{IH}(\min)$, CS* $\geq V_{IH}(\min)$, $t_{CC}=10\text{ns}$ Input signals are changed one time during 20ns	100				mA	
	I_{CC3NS}	CKE $\geq V_{IH}(\min)$ CLK $\leq V_{IL}(\max)$, $t_{CC}=\infty$ Input signals are stable	60					
Operating current (Burst mode)	I_{CC4}	$I_O = 0$ mA Page burst 4Banks Activated $t_{CCD} = 2\text{CLKs}$	540	520	500	500	mA	1
Refresh current	I_{CC5}	$t_{RC} \geq t_{RC}(\min)$	540	520	500	500	mA	2
Self refresh current	I_{CC6}	CKE $\leq 0.2\text{V}$	4				mA	G
			1.6				mA	F

Notes :

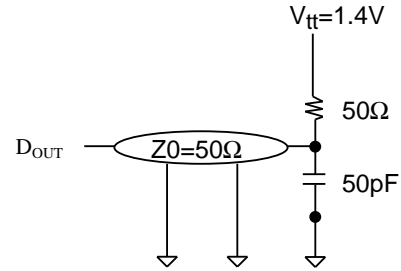
1. Measured with outputs open.
2. Refresh period is 64ms.
3. Unless otherwise noticed, input swing level is CMOS($V_{IH}/V_{IL}=V_{DDQ}/V_{SSQ}$).

AC OPERATING TEST CONDITIONS(vcc = 3.3V \pm 0.3V, TA = 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
		-13	-12	-10	-10L		
Row active to row active delay	$t_{RRD}(\text{min})$	15	16	20	20	ns	1
RAS to CAS delay	$t_{RP}(\text{min})$	20	20	20	20	ns	1
Row precharge time	$t_{RP}(\text{min})$	20	20	20	20	ns	1
Row active time	$t_{RAS}(\text{min})$	45	48	50	50	ns	1
	$t_{RAS}(\text{max})$	100				ns	
Row cycle time	$t_{RC}(\text{min})$	65	68	70	70	ns	1
Last data in to row precharge	$t_{RDL}(\text{min})$	2				CLK	2.5
Last data in to Active delay	$t_{DAL}(\text{min})$	2 CLK + 20 ns					
Last data in to new col. address delay	$t_{CDL}(\text{min})$	1				CLK	2
Last data in to burst stop	$t_{BDL}(\text{min})$	1				CLK	2
Col. address to col. address delay	$t_{CCD}(\text{min})$	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.

AC CHARACTERISTICS

(AC operating conditions unless otherwise noted)

PARAMETER		SYMBOL	-A		-8		-H		-L		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 :

- Parameters depend on programmed CAS latency.
- If clock rising time is longer than 1ns, $(tr/2-0.5)ns$ should be added to the parameter.
- 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	BA 0,1	A10/AP	A11 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	H	H	H	X	X			3
		Exit	L	H	L	H	H		X			3
					H	X	X	X				
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			
	Exit			L	H	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 :

- OP Code : Operand code
A0 ~ A11 & BA0 ~ BA1 : Program keys. (@ MRS)
- MRS can be issued only at all banks precharge state.
A new command can be issued after 2 CLK cycles of MRS.
- 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.
- 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.
- 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.
- Burst stop command is valid at every burst length.
- 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)

ORDERING INFORMATION

Part Number	Density	Org.	Package	Ref.	Vcc	CL	MAX.frq
HSD8M32B4-10	32MByte	8Mx 32	144 Pin SO-DIMM	4K	3.3V	CL=2	100MHz
HSD8M32B4-10L	32MByte	8Mx 32	144 Pin SO-DIMM	4K	3.3V	CL=3	100MHz
HSD8M32B4-12	32MByte	8Mx 32	144 Pin SO-DIMM	4K	3.3V	CL=3	125MHz
HSD8M32B4-13	32MByte	8Mx 32	144 Pin SO-DIMM	4K	3.3V	CL=3	133MHz