

HM51256 Series

262144-word × 1-bit CMOS Dynamic Random Access Memory

■FEATURE

- 262, 144 word x 1 bit DRAM
- Double layer Poly-Si/Polycide Process, high performance CMOS
- Power supply voltage: 5V ± 10%
- Access time
 - Row access time: 85/100/120/150ns
 - Address access time: 40/45/55/70ns
- Cycle time
 - Random read/write cycle time: 155/180/210/250ns
 - High speed page mode cycle time: 50/55/65/80ns
- Lower power
 - Standby: 11mW (TTL Level)
 - 1.1mW (CMOS Level: L-version)
 - Active: 385/330/275/220mW
- Refresh: 256 cycles/4ms
 - 256 cycles/32ms (L-version)
- Refresh function: RAS only refresh, $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh, Hidden refresh
- High speed page mode capability
- Edge triggered write capability
- Fast $\overline{\text{CAS}}$ output control

HM51256P Series
HM51256LP Series



(DP-16B)

HM51256CP Series
HM51256LCP Series



(CP-18)

HM51256ZP Series
HM51256LZP Series



(ZP-16)

■ ORDERING INFORMATION

Type No.	Access Time	Package
HM51256P-8	85ns	300 mil 16 pin Plastic DIP
HM51256P-10	100ns	
HM51256P-12	120ns	
HM51256P-15	150ns	
HM51256CP-8	85ns	18 Pin PLCC
HM51256CP-10	100ns	
HM51256CP-12	120ns	
HM51256CP-15	150ns	
HM51256LP-8	85ns	300 mil 16 pin Plastic DIP
HM51256LP-10	100ns	
HM51256LP-12	120ns	
HM51256LP-15	150ns	
HM51256LCP-8	85ns	18 pin PLCC
HM51256LCP-10	100ns	
HM51256LCP-12	120ns	
HM51256LCP-15	150ns	
HM51256ZP-8	85ns	16 pin Plastic ZIP
HM51256ZP-10	100ns	
HM51256ZP-12	120ns	
HM51256ZP-15	150ns	
HM51256LZP-8	85ns	
HM51256LZP-10	100ns	
HM51256LZP-12	120ns	
HM51256LZP-15	150ns	

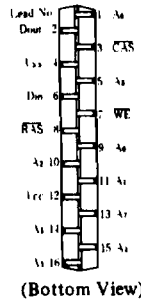
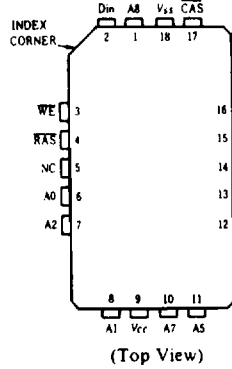
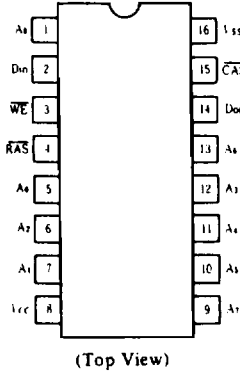


■ PIN ARRANGEMENT

- HM51256P Series
HM51256LP Series

- HM51256CP Series
HM51256LCP Series

- HM51256ZP Series
HM51256LZP Series

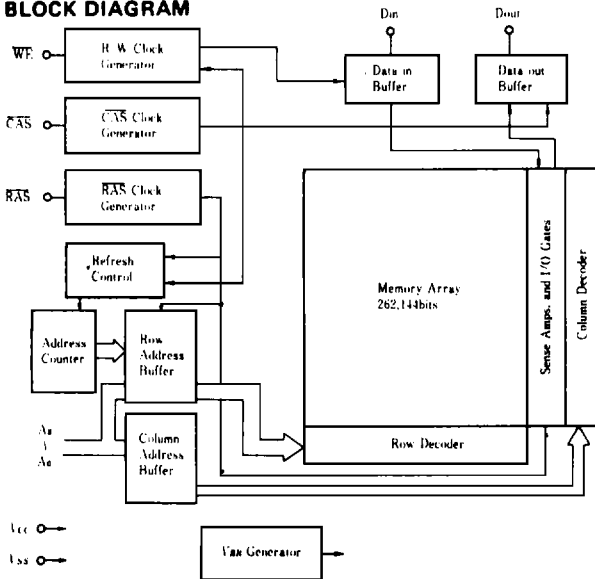


A ₆ - A ₁	Address Inputs
CAS	Column Address Strobe
Din	Data In
Dout	Data Out
RAS	Row Address Strobe
WE	Read/Write Input
V _{cc}	Power (+5V)
V _{ss}	Ground
A ₆ - A ₇	Refresh Address Inputs

■ ABSOLUTE MAXIMUM RATINGS

- Voltage on any pin relative to V_{SS} -1V to +7V
- Operating temperature, T_a (Ambient) 0°C to +70°C
- Storage temperature -55°C to +125°C
- Short circuit output current 50mA
- Power dissipation 1W

■ BLOCK DIAGRAM



■ RECOMMENDED DC OPERATING CONDITIONS (T_a=0 to +70°C)

Parameter	Symbol	min	typ	max	Unit	Note
Supply Voltage	V _{cc}	4.5	5.0	5.5	V	1
Input High Voltage	V _{IH}	2.4	—	6.5	V	1
Input Low Voltage	V _{IL}	-1.0	—	0.8	V	1

Note) 1. All voltages referenced to V_{ss}.



■DC ELECTRICAL CHARACTERISTICS ($T_a=0$ to $+70^{\circ}\text{C}$, $V_{CC}=5\text{V}\pm 10\%$, $V_{SS}=0\text{V}$)

Parameter	Symbol	HM51256-8		HM51256-10		HM51256-12		HM51256-15		Unit	Notes
		min	max	min	max	min	max	min	max		
Operating Current (RAS, CAS Cycling: $t_{RC} = \text{min}$)	I_{CC1}	-	70	-	60	-	50	-	40	mA	1
Standby Current (RAS = V_{IH} , Dout = High Impedance)	I_{CC2}	-	2	-	2	-	2	-	2	mA	
Refresh Current (RAS only Refresh, $t_{RC} = \text{min}$)	I_{CC3}	-	70	-	60	-	50	-	40	mA	
Standby Current (RAS = V_{IH} , Dout Enable)	I_{CC4}	-	6	-	6	-	6	-	6	mA	1
Refresh Current (CAS before RAS Refresh, $t_{RC} = \text{min}$)	I_{CC5}	-	60	-	55	-	45	-	35	mA	
High Speed Page Mode Supply Current (RAS = V_{IL} , CAS Cycling, $t_{RC} = \text{min}$)	I_{CC6}	-	70	-	60	-	50	-	40	mA	1
Standby Current (RAS, CAS = $V_{CC} - 0.2\text{V}$)	I_{CC7}	-	200	-	200	-	200	-	200	μA	2
Input leakage ($0 < V_{in} < 7\text{V}$)	I_{II}	-10	10	-10	10	-10	10	-10	10	μA	
Output leakage ($0 < V_{out} < 7\text{V}$, Dout = Disable)	I_{IO}	-10	10	-10	10	-10	10	-10	10	μA	
Output levels High ($I_{OH} = 5\text{mA}$)	V_{OH}	2.4	V_{CC}	2.4	V_{CC}	2.4	V_{CC}	2.4	V_{CC}	V	
Output levels Low ($I_{OL} = 4.2\text{mA}$)	V_{OL}	0	0.4	0	0.4	0	0.4	0	0.4	V	

Notes: 1. I_{CC} depends on output loading condition when the device is selected. I_{CC} max. is specified at the output open condition.
 2. This specification is guaranteed only for L version.

■CAPACITANCE ($V_{CC}=5\text{V}\pm 10\%$, $T_a=25^{\circ}\text{C}$)

Parameter	Symbol	typ	max	Unit	Notes	
Input Capacitance	Address, Data-in	C_{II}	-	5	pF	1
	Clocks	$C_{\bar{A}}$	-	7		1
Output Capacitance	Data out	C_{O}	-	7		1, 2

Notes: 1. Capacitance measured with Boonton Meter or effective capacitance measuring method.
 2. CAS = V_{IH} to disable Dout.

■ELECTRICAL CHARACTERISTICS AND RECOMMENDED AC OPERATING CONDITIONS

($T_a=0$ to $+70^{\circ}\text{C}$, $V_{CC}=5\text{V}\pm 10\%$, $V_{SS}=0\text{V}$)

● Read, Write, Read-Modify-Write and Refresh Cycles (Common Parameter)

Parameter	Symbol	HM51256-8		HM51256-10		HM51256-12		HM51256-15		Unit	Notes
		min	max	min	max	min	max	min	max		
Random Read or Write Cycle Time	t_{RC}	155	-	180	-	210	-	250	-	ns	
RAS Precharge Time	t_{RP}	60	-	70	-	80	-	90	-	ns	
RAS Pulse Width	t_{RAS}	55	10000	65	10000	75	10000	95	10000	ns	
CAS Pulse Width	t_{CAS}	25	-	25	-	30	-	35	-	ns	
Column Address Set-up Time	t_{ASC}	0	-	0	-	0	-	0	-	ns	
Column Address Hold Time	t_{CAH}	15	-	20	-	25	-	30	-	ns	
Column Address Hold Time to RAS	t_{AR}	60	-	75	-	90	-	110	-	ns	
RAS to CAS Delay Time	t_{RCD}	20	60	25	75	25	90	30	115	ns	8
RAS to Column Address Delay Time	t_{RAD}	15	45	20	55	20	65	25	80	ns	9
RAS Hold Time	t_{RSH}	20	-	25	-	30	-	35	-	ns	
CAS Hold Time	t_{CSH}	85	-	100	-	120	-	150	-	ns	
CAS to RAS Precharge Time	t_{CRP}	10	-	10	-	10	-	10	-	ns	
Row Address Set-up Time	t_{ASR}	0	-	0	-	0	-	0	-	ns	
Row Address Hold Time	t_{RAH}	10	-	15	-	15	-	20	-	ns	
Transition Time (Rise and Fall)	t_T	3	50	3	50	3	50	3	50	ns	7
Refresh Period	t_{REF}	-	4	-	4	-	4	-	4	ms	
		-	32	-	32	-	32	-	32	ms	21

● Read Cycle

Parameter	Symbol	HM51256-8		HM51256-10		HM51256-12		HM51256-15		Unit	Notes
		min	max	min	max	min	max	min	max		
Access Time from RAS	t_{RAA}	-	85	-	100	-	120	-	150	ns	2, 3
Access Time from CAS	t_{CAI}	-	25	-	25	-	30	-	35	ns	3, 4
Access Time from Address	t_{AA}	-	40	-	45	-	55	-	70	ns	3.5, 14
Read Command Set-up Time	$t_{RC'S}$	0	-	0	-	0	-	0	-	ns	
Read Command Hold Time to CAS	t_{RCH}	0	-	0	-	0	-	0	-	ns	
Read Command Hold Time to RAS	t_{RRH}	10	-	10	-	10	-	10	-	ns	
Column Address to RAS Lead Time	t_{CAL}	40	-	45	-	55	-	70	-	ns	
Output Buffer Turn-off Time	t_{OFF}	0	20	0	25	0	30	0	35	ns	6



● Write Cycle

Parameter	Symbol	HM51256-8		HM51256-10		HM51256-12		HM51256-15		Unit	Notes
		min	max	min	max	min	max	min	max		
Write Command Set-up Time	t_{WCS}	0	-	0	-	0	-	0	-	ns	10
Write Command Hold Time	t_{WCH}	20	-	25	-	30	-	35	-	ns	
Write Command Hold Time to \overline{RAS}	t_{WCH}	65	-	80	-	95	-	115	-	ns	
Write Command Pulse Width	t_{WP}	15	-	20	-	25	-	30	-	ns	
Write Command to RAS Lead Time	t_{RWL}	20	-	25	-	30	-	35	-	ns	
Write Command to \overline{CAS} Lead Time	t_{RWL}	20	-	25	-	30	-	35	-	ns	
Data-in Set-up Time	t_{DS}	0	-	0	-	0	-	0	-	ns	11
Data-in Hold Time	t_{DH}	15	-	20	-	25	-	30	-	ns	10, 11
Data-in Hold Time to RAS	t_{DHR}	60	-	75	-	90	-	110	-	ns	

● Read-Modify-Write Cycle

Parameter	Symbol	HM51256-8		HM51256-10		HM51256-12		HM51256-15		Unit	Notes
		min	max	min	max	min	max	min	max		
Read-Write Cycle Time	t_{RWC}	180	-	210	-	245	-	290	-	ns	
\overline{RAS} to \overline{WE} Delay Time	t_{RWD}	85	-	100	-	120	-	150	-	ns	10
\overline{CAS} to \overline{WE} Delay Time	t_{CWD}	20	-	25	-	30	-	35	-	ns	10
Column Address to \overline{WE} Delay Time	t_{AWD}	40	-	45	-	55	-	70	-	ns	10

● Refresh Cycle

Parameter	Symbol	HM51256-8		HM51256-10		HM51256-12		HM51256-15		Unit	Notes
		min	max	min	max	min	max	min	max		
CAS Set-up Time (CAS before RAS Refresh)	t_{CSR}	10	-	10	-	10	-	10	-	ns	
CAS Hold Time (CAS before RAS Refresh)	t_{CHR}	10	-	10	-	10	-	10	-	ns	
\overline{RAS} Precharge to \overline{CAS} Hold Time	t_{RPC}	15	-	15	-	15	-	15	-	ns	

● High Speed Page Mode Cycle

Parameter	Symbol	HM51256-8		HM51256-10		HM51256-12		HM51256-15		Unit	Notes
		min	max	min	max	min	max	min	max		
High Speed Page Mode Cycle Time	t_{PC}	50	-	55	-	65	-	80	-	ns	18, 20
High Speed Page Mode RAS Pulse Width	t_{RPPC}	55	75000	65	75000	75	75000	95	75000	ns	19
RAS to Second WE Delay Time	t_{RSW}	90	-	105	-	125	-	155	-	ns	
CAS Precharge Time	t_{CP}	10	-	15	-	20	-	20	-	ns	
Write Invalid Time	t_{WI}	10	-	10	-	15	-	15	-	ns	
Access Time from Column Precharge Time	t_{CAP}	-	45	-	50	-	60	-	75	ns	20

● High Speed Page Mode Read-Modify-Write Cycle

Parameter	Symbol	HM51256-8		HM51256-10		HM51256-12		HM51256-15		Unit	Notes
		min	max	min	max	min	max	min	max		
High Speed Page Mode Cycle Time on Read-Write	t_{RWPC}	85	-	95	-	115	-	145	-	ns	12
Access Time from Previous WE	t_{AWA}	-	80	-	90	-	110	-	140	ns	3, 13
Previous WE to Column Address Delay Time	t_{AWD}	20	40	25	45	30	55	35	70	ns	15

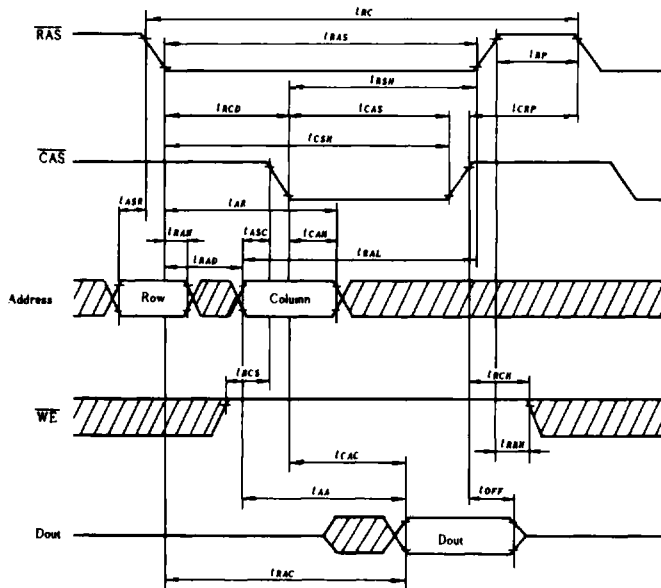
- Notes:
1. AC measurements assume $t_T = 5ns$.
 2. Assumes that $t_{RCD} \leq t_{RCD} (max)$ and $t_{RAD} \leq t_{RAD} (max)$. If t_{RCD} or t_{RAD} is greater than the maximum recommended value shown in this table t_{RAC} exceeds the value shown.
 3. Measured with a load circuit equivalent to 2TTL loads and 100pF.
 4. Assumes that $t_{RCD} \geq t_{RCD} (max)$ and $t_{RAD} \leq t_{RAD} (max)$.
 5. Assumes that $t_{RCD} \leq t_{RCD} (max)$ and $t_{RAD} \geq t_{RAD} (max)$.
 6. $t_{OFF} (max)$ is defined as the time at which the output achieves the open circuit condition and is not referenced to output voltage levels.



7. V_{IH} (min) and V_{IL} (max) are reference levels for measuring timing of input signals. Also, transition times are measured between V_{IH} and V_{IL} .
8. Operation with the t_{RCD} (max) limit insures that t_{RAC} (max) can be met, t_{RCD} (max) is specified as a reference point only, if t_{RCD} is greater than the specified t_{RCD} (max) limit, then access time is controlled exclusively by t_{CAC} .
9. Operation with the t_{RAD} (max) limit insures that t_{RAC} (max) can be met, t_{RAD} (max) is specified as a Reference point only, if t_{RAD} is greater than the specified t_{RAD} (max) limit, then access time is controlled exclusively by t_{AA} .
10. t_{WCS} , t_{RWD} , t_{CWD} and t_{AWD} are not restrictive operating parameters. They are included in the data sheet as electrical characteristics only: if $t_{WCS} \geq t_{WCS}$ (min), the cycle is an early write cycle and the data out pin will remain open circuit (high impedance) throughout the entire cycle; if $t_{RWD} \geq t_{RWD}$ (min), $t_{CWD} \geq t_{CWD}$ (min) and $t_{AWD} \geq t_{AWD}$ (min), the cycle is a read/write and the data output will contain data read from the selected cell; if neither of the above sets of conditions is satisfied, the condition of the data out (at access time) is indeterminate.
11. These parameters are referenced to \overline{CAS} leading edge in early write cycles and to \overline{WE} leading edge in delayed write or read-modify-write cycles.
12. t_{RWPC} (min) = t_{AWD} (min) + t_{WAD} (max) + t_T .
13. Assumes that $t_{WAD} \leq t_{WAD}$ (max). If t_{WAD} is greater than the maximum recommended value shown in this table, t_{PWA} exceeds the value shown.
14. Assumes that $t_{WAD} \geq t_{WAD}$ (max).
15. Operation with the t_{WAD} (max) limit insures that t_{PWA} (max) can be met, t_{WAD} (max) is specified as a reference point only, if t_{WAD} is greater than the specified t_{WAD} (max) limit, then access time is controlled exclusively by t_{AA} .
16. An initial pause of 100 μ s is required after power-up then execute at least 8 initialization cycles.
17. At least, 8 \overline{CAS} before \overline{RAS} refresh cycles are required before using internal refresh counter.
18. Assumes that $t_{ASC} = t_{CP} - 5$ ns.
19. t_{RIPC} is determined by \overline{RAS} pulse width in High Speed Page mode cycle.
20. Access time is determined by the longer of t_{AA} , t_{CAC} or t_{CAP} .
21. This specification is guaranteed only for L-version.

■TIMING WAVEFORMS

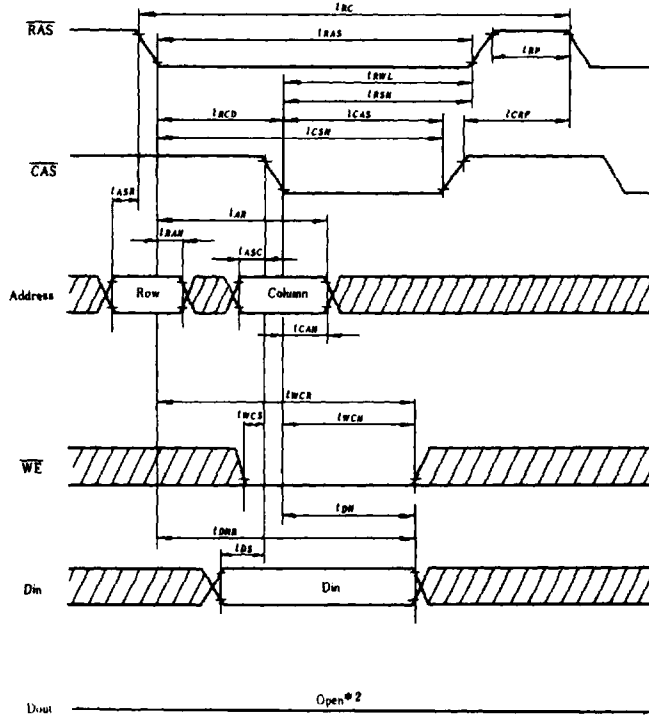
●Read Cycle



Note) : Don't care

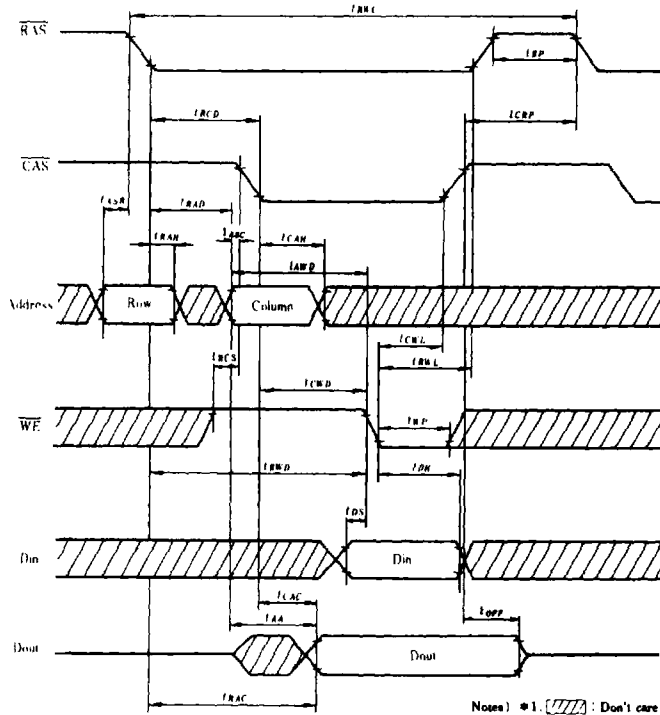


● Write Cycle



● Read Modify Write Cycle

Notes: *1. : Don't care
*2. $t_{RC} \geq t_{RC}(\min)$



Notes) *1. : Don't care
*2. $t_{AND} \geq t_{RD}(\min)$
 $t_{CRD} \geq t_{CRD}(\min)$
 $t_{AND} \geq t_{AND}(\min)$



