

**DRAM MODULE**

**M53230404BY0/BT0-C**

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# 4Byte 4Mx32 SIMM

(4Mx16 base)

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Revision 0.1

June 1998



## DRAM MODULE

## M53230404BY0/BT0-C

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### Revision History

#### Version 0.0 (Sept. 1997)

- Removed two AC parameters tCACP(access time from  $\overline{\text{CAS}}$ ) and tAAP(access time from col. addr.) in AC CHARACTERISTICS.
- Changed the parameter tCAC(access time from  $\overline{\text{CAS}}$ ) from 13ns to 15ns @ -5 in AC CHARACTERISTICS.

#### Version 0.0 (June 1998)

- The 3rd. generation of 64M DRAM components are applied for this module.



**DRAM MODULE****M53230404BY0/BT0-C****M53230404BY0/BT0-C EDO Mode**

4M x 32 DRAM SIMM Using 4Mx16, 4K Refresh, 5V

**GENERAL DESCRIPTION**

The Samsung M53230404BY0/BT0-C is a 4Mx32bits Dynamic RAM high density memory module. The Samsung M53230404BY0/BT0-C consists of two CMOS 4Mx16bits DRAMs in TSOP packages mounted on a 72-pin glass-epoxy substrate. A 0.1 or 0.22uF decoupling capacitor is mounted on the printed circuit board for each DRAM. The M53230404BY0/BT0-C is a Single In-line Memory Module with edge connections and is intended for mounting into 72 pin edge connector sockets.

**PERFORMANCE RANGE**

Speed	t <sub>RAC</sub>	t <sub>CAC</sub>	t <sub>RC</sub>	t <sub>HPC</sub>
-C50	50ns	13ns	84ns	20ns
-C60	60ns	15ns	104ns	25ns

**FEATURES**

- Part Identification
  - M53230404BY0-C(4K cycles/64ms Ref, TSOP, Solder)
  - M53230404BT0-C(4K cycles/64ms Ref, TSOP, Gold)
- Extended Data Out Mode Operation
- $\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$  & Hidden Refresh capability
- $\overline{\text{RAS}}$ -only refresh capability
- TTL compatible inputs and outputs
- Single +5V±10% power supply
- JEDEC standard PDpin & pinout
- PCB : Height(1000mil), single sided component

**PIN CONFIGURATIONS**

Pin	Symbol	Pin	Symbol
1	Vss	37	NC
2	DQ0	38	NC
3	DQ18	39	$\overline{\text{Vss}}$
4	DQ1	40	$\overline{\text{CAS0}}$
5	DQ19	41	$\overline{\text{CAS2}}$
6	DQ2	42	$\overline{\text{CAS3}}$
7	DQ20	43	$\overline{\text{CAS1}}$
8	DQ3	44	$\overline{\text{RAS0}}$
9	DQ21	45	NC
10	Vcc	46	NC
11	NC	47	W
12	A0	48	NC
13	A1	49	DQ9
14	A2	50	DQ27
15	A3	51	DQ10
16	A4	52	DQ28
17	A5	53	DQ11
18	A6	54	DQ29
19	A10	55	DQ12
20	DQ4	56	DQ30
21	DQ22	57	DQ13
22	DQ5	58	DQ31
23	DQ23	59	Vcc
24	DQ6	60	DQ32
25	DQ24	61	DQ14
26	DQ7	62	DQ33
27	DQ25	63	DQ15
28	A7	64	DQ34
29	A11	65	DQ16
30	Vcc	66	NC
31	A8	67	PD1
32	A9	68	PD2
33	$\overline{\text{NC}}$	69	PD3
34	$\overline{\text{RAS2}}$	70	PD4
35	NC	71	NC
36	NC	72	Vss

**PIN NAMES**

Pin Name	Function
A0 - A11	Address Inputs
DQ0-7, DQ9-16 DQ18-25, DQ27-34	Data In/Out
$\overline{\text{W}}$	Read/Write Enable
$\overline{\text{RAS0}}$ , $\overline{\text{RAS2}}$	Row Address Strobe
$\overline{\text{CAS0}}$ - $\overline{\text{CAS3}}$	Column Address Strobe
PD1 - PD4	Presence Detect
Vcc	Power(+5V)
Vss	Ground
NC	No Connection

**PRESENCE DETECT PINS (Optional)**

Pin	50NS	60NS
PD1	Vss	Vss
PD2	NC	NC
PD3	Vss	NC
PD4	Vss	NC

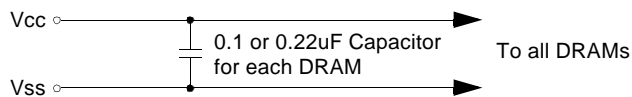
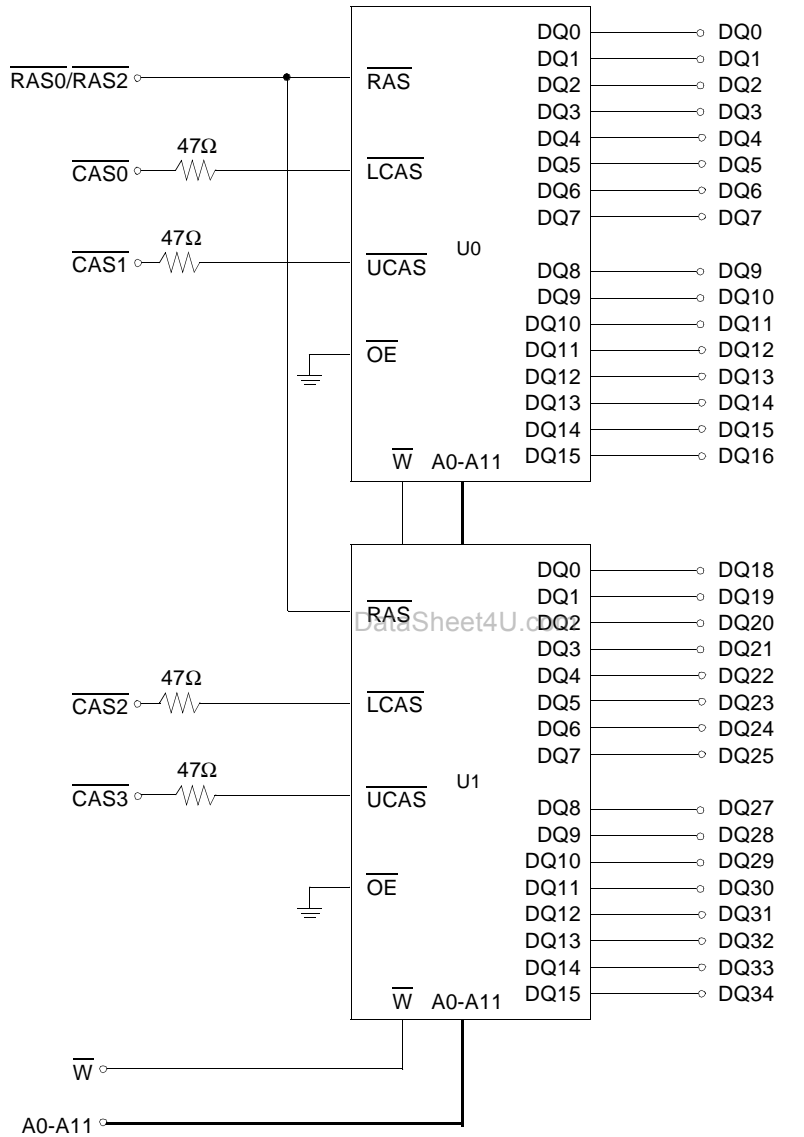
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# DRAM MODULE

# M53230404BY0/BT0-C

## FUNCTIONAL BLOCK DIAGRAM



## DRAM MODULE

## M53230404BY0/BT0-C

## ABSOLUTE MAXIMUM RATINGS \*

Item	Symbol	Rating	Unit
Voltage on any pin relative to Vss	V <sub>IN</sub> , V <sub>OUT</sub>	-1 to +7.0	V
Voltage on Vcc supply relative to Vss	V <sub>CC</sub>	-1 to +7.0	V
Storage Temperature	T <sub>stg</sub>	-55 to +125	°C
Power Dissipation	P <sub>d</sub>	2	W
Short Circuit Output Current	I <sub>OS</sub>	50	mA

\* 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 intended periods may affect device reliability.

## RECOMMENDED OPERATING CONDITIONS (Voltage referenced to Vss, TA = 0 to 70°C)

Item	Symbol	Min	Typ	Max	Unit
Supply Voltage	V <sub>CC</sub>	4.5	5.0	5.5	V
Ground	V <sub>SS</sub>	0	0	0	V
Input High Voltage	V <sub>IH</sub>	2.4	-	V <sub>CC</sub> *1	V
Input Low Voltage	V <sub>IL</sub>	-1.0*2	-	0.8	V

\*1 : V<sub>CC</sub>+2.0V at pulse width≤20ns, which is measured at V<sub>CC</sub>.

\*2 : -2.0V at pulse width≤20ns, which is measured at V<sub>SS</sub>.

## DC AND OPERATING CHARACTERISTICS (Recommended operating conditions unless otherwise noted)

Symbol	Speed	M53230404BY0/BT0		Unit
		Min	Max	
I <sub>CC1</sub>	-50	-	240	mA
	-60	-	220	mA
I <sub>CC2</sub>	Don't care	-	4	mA
I <sub>CC3</sub>	-50	-	240	mA
	-60	-	220	mA
I <sub>CC4</sub>	-50	-	220	mA
	-60	-	200	mA
I <sub>CC5</sub>	Don't care	-	2	mA
I <sub>CC6</sub>	-50	-	240	mA
	-60	-	220	mA
I <sub>I(L)</sub> I <sub>O(L)</sub>	Don't care	-10	10	µA
		-5	5	µA
V <sub>OH</sub> V <sub>OL</sub>	Don't care	2.4	-	V
		-	0.4	V

I<sub>CC1</sub> : Operating Current \* ( $\overline{\text{RAS}}$ ,  $\overline{\text{CAS}}$ , Address cycling @ t<sub>RC</sub>=min)

I<sub>CC2</sub> : Standby Current ( $\overline{\text{RAS}}=\overline{\text{CAS}}=\overline{\text{W}}=V_{IH}$ )

I<sub>CC3</sub> :  $\overline{\text{RAS}}$  Only Refresh Current \* ( $\overline{\text{CAS}}=V_{IH}$ ,  $\overline{\text{RAS}}$  cycling @ t<sub>RC</sub>=min)

I<sub>CC4</sub> : Hyper Page Mode Current \* ( $\overline{\text{RAS}}=V_{IL}$ ,  $\overline{\text{CAS}}$  cycling : t<sub>HPC</sub>=min)

I<sub>CC5</sub> : Standby Current ( $\overline{\text{RAS}}=\overline{\text{CAS}}=\overline{\text{W}}=V_{CC}-0.2V$ )

I<sub>CC6</sub> :  $\overline{\text{CAS}}$ -Before- $\overline{\text{RAS}}$  Refresh Current \* ( $\overline{\text{RAS}}$  and  $\overline{\text{CAS}}$  cycling @ t<sub>RC</sub>=min)

I<sub>I(L)</sub> : Input Leakage Current (Any input 0≤V<sub>IN</sub>≤V<sub>CC</sub>+0.5V, all other pins not under test=0 V)

I<sub>O(L)</sub> : Output Leakage Current(Data Out is disabled, 0V≤V<sub>OUT</sub>≤V<sub>CC</sub>)

V<sub>OH</sub> : Output High Voltage Level (I<sub>OH</sub> = -5mA)

V<sub>OL</sub> : Output Low Voltage Level (I<sub>OL</sub> = 4.2mA)

\* **NOTE** : I<sub>CC1</sub>, I<sub>CC3</sub>, I<sub>CC4</sub> and I<sub>CC6</sub> are dependent on output loading and cycle rates. Specified values are obtained with the output open. I<sub>CC</sub> is specified as an average current. In I<sub>CC1</sub> and I<sub>CC3</sub>, address can be changed maximum once while RAS=V<sub>IL</sub>. In I<sub>CC4</sub>, address can be changed maximum once within one EDO mode cycle time, t<sub>HPC</sub>.



**DRAM MODULE****M53230404BY0/BT0-C****CAPACITANCE** ( $T_A = 25^\circ\text{C}$ ,  $V_{CC}=5\text{V}$ ,  $f = 1\text{MHz}$ )

Item	Symbol	Min	Max	Unit
Input capacitance[A0-A11]	C <sub>IN1</sub>	-	20	pF
Input capacitance[ $\overline{W}$ ]	C <sub>IN2</sub>	-	24	pF
Input capacitance[RAS0/RAS2]	C <sub>IN3</sub>	-	24	pF
Input capacitance[CAS0 - CAS3]	C <sub>IN4</sub>	-	17	pF
Input/Output capacitance[DQ0-7, 9-16,18-25, 27-34]	C <sub>DQ</sub>	-	17	pF

**AC CHARACTERISTICS** ( $0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$ ,  $V_{CC}=5.0\text{V} \pm 10\%$ . See notes 1,2.)Test condition :  $V_{ih}/V_{il}=2.6/0.8\text{V}$ ,  $V_{oh}/V_{ol}=2.0/0.8\text{V}$ , output loading  $C_L=100\text{pF}$ 

Parameter	Symbol	-50		-60		Unit	Note
		Min	Max	Min	Max		
Random read or write cycle time	t <sub>RC</sub>	84		104		ns	
Access time from RAS	t <sub>RAC</sub>		50		60	ns	3,4,10
Access time from $\overline{\text{CAS}}$	t <sub>CAC</sub>		13		15	ns	3,4,5
Access time from column address	t <sub>AA</sub>		25		30	ns	3,10
$\overline{\text{CAS}}$ to output in Low-Z	t <sub>CLZ</sub>	3		3		ns	3
Output buffer turn-off delay from $\overline{\text{CAS}}$	t <sub>CEZ</sub>	3	13	3	13	ns	6,12
Transition time(rise and fall)	t <sub>T</sub>	1	50	1	50	ns	2
RAS precharge time	t <sub>RP</sub>	30		40		ns	
RAS pulse width	t <sub>RAS</sub>	50	10K	60	10K	ns	
RAS hold time	t <sub>RSH</sub>	13		15		ns	
$\overline{\text{CAS}}$ hold time	t <sub>CSH</sub>	38		45		ns	
$\overline{\text{CAS}}$ pulse width	t <sub>CAS</sub>	8	10K	10	10K	ns	4
RAS to $\overline{\text{CAS}}$ delay time	t <sub>RC<sub>D</sub></sub>	20	37	20	45	ns	9
RAS to column address delay time	t <sub>RAD</sub>	15	25	15	30	ns	
$\overline{\text{CAS}}$ to RAS precharge time	t <sub>CRP</sub>	5		5		ns	
Row address set-up time	t <sub>ASR</sub>	0		0		ns	
Row address hold time	t <sub>RAH</sub>	10		10		ns	
Column address set-up time	t <sub>ASC</sub>	0		0		ns	
Column address hold time	t <sub>CAH</sub>	8		10		ns	
Column address to RAS lead time	t <sub>RAL</sub>	25		30		ns	
Read command set-up time	t <sub>RCS</sub>	0		0		ns	
Read command hold referenced to $\overline{\text{CAS}}$	t <sub>RCH</sub>	0		0		ns	8
Read command hold referenced to RAS	t <sub>RRH</sub>	0		0		ns	8
Write command set-up time	t <sub>WCS</sub>	0		0		ns	7
Write command hold time	t <sub>WCH</sub>	10		10		ns	
Write command pulse width	t <sub>WP</sub>	10		10		ns	
Write command to RAS lead time	t <sub>RWL</sub>	13		15		ns	
Write command to $\overline{\text{CAS}}$ lead time	t <sub>CWL</sub>	8		10		ns	
Data set-up time	t <sub>DS</sub>	0		0		ns	9
Data hold time	t <sub>DH</sub>	8		10		ns	9
Refresh period	t <sub>REF</sub>		64		64	ms	
$\overline{\text{CAS}}$ setup time ( $\overline{\text{CAS}}$ -before-RAS refresh)	t <sub>CSR</sub>	5		5		ns	
$\overline{\text{CAS}}$ hold time ( $\overline{\text{CAS}}$ -before-RAS refresh)	t <sub>CHR</sub>	10		10		ns	
RAS to $\overline{\text{CAS}}$ precharge time	t <sub>RPC</sub>	5		5		ns	
Access time from $\overline{\text{CAS}}$ precharge	t <sub>CPA</sub>		28		35	ns	3



## DRAM MODULE

## M53230404BY0/BT0-C

AC CHARACTERISTICS (0°C≤T<sub>A</sub>≤70°C, V<sub>CC</sub>=5.0V±10%. See notes 1,2.)Test condition : V<sub>IH</sub>/V<sub>IL</sub>=2.6/0.8V, V<sub>OH</sub>/V<sub>OL</sub>=2.0/0.8V, output loading CL=100pF

Parameter	Symbol	-50		-60		Unit	Note
		Min	Max	Min	Max		
Hyper page mode cycle time	t <sub>HPC</sub>	20		25		ns	11
CAS precharge time (Hyper page cycle)	t <sub>CP</sub>	8		10		ns	
RAS pulse width (Hyper page cycle)	t <sub>RASP</sub>	50	200K	60	200K	ns	
RAS hold time from CAS precharge	t <sub>RHCP</sub>	30		35		ns	
W to RAS precharge time(C-B-R refresh)	t <sub>WRP</sub>	10		10		ns	
W to RAS hold time(C-B-R refresh)	t <sub>WRH</sub>	10		10		ns	
Output data hold time	t <sub>DOH</sub>	5		5		ns	
Output buffer turn off delay from RAS	t <sub>REZ</sub>	3	13	3	15	ns	6,12
Output buffer turn off delay from W	t <sub>WEZ</sub>	3	13	3	15	ns	6
W to data delay	t <sub>WED</sub>	15		15		ns	
W pulse width	t <sub>WPE</sub>	5		5		ns	

## NOTES

- An initial pause of 200us is required after power-up followed by any 8 RAS-only or CAS-before-RAS refresh cycles before proper device operation is achieved.
- Input voltage levels are V<sub>IH</sub>/V<sub>IL</sub>. V<sub>IH</sub>(min) and V<sub>IL</sub>(max) are reference levels for measuring timing of input signals. Transition times are measured between V<sub>IH</sub>(min) and V<sub>IL</sub>(max) and are assumed to be 5ns for all inputs.
- Measured with a load equivalent to 2 TTL loads and 100pF.
- Operation within the t<sub>RCD</sub>(max) limit insures that t<sub>RAC</sub>(max) can be met. t<sub>RCD</sub>(max) is specified as a reference point only. If t<sub>RCD</sub> is greater than the specified t<sub>RCD</sub>(max) limit, then access time is controlled exclusively by t<sub>CAC</sub>.
- Assumes that t<sub>RCD</sub>≥t<sub>RCD</sub>(max).
- This parameter defines the time at which the output achieves the open circuit and is not referenced for V<sub>OH</sub> or V<sub>OL</sub>.
- t<sub>WCS</sub> is non-restrictive operating parameter. It is included in the data sheet as electrical characteristics only. If t<sub>WCS</sub>≥t<sub>WCS</sub>(min), the cycle is an early write cycle and the data out pin will remain high impedance for the duration of the cycle.
- Either t<sub>TRCH</sub> or t<sub>TRRH</sub> must be satisfied for a read cycle.
- These parameters are referenced to the CAS leading edge in early write cycles.
- Operation within the t<sub>TRAD</sub>(max) limit insures that t<sub>RAC</sub>(max) can be met. t<sub>TRAD</sub>(max) is specified as reference point only. If t<sub>TRAD</sub> is greater than the specified t<sub>TRAD</sub>(max) limit access time is controlled by t<sub>AA</sub>.
- t<sub>ASC</sub>≥6ns, Assume t<sub>T</sub>=2.0ns.
- If RAS goes high before CAS high going, the open circuit condition of the output is achieved by CAS high going. If CAS goes high before RAS high going, the open circuit condition of the output is achieved by RAS going.

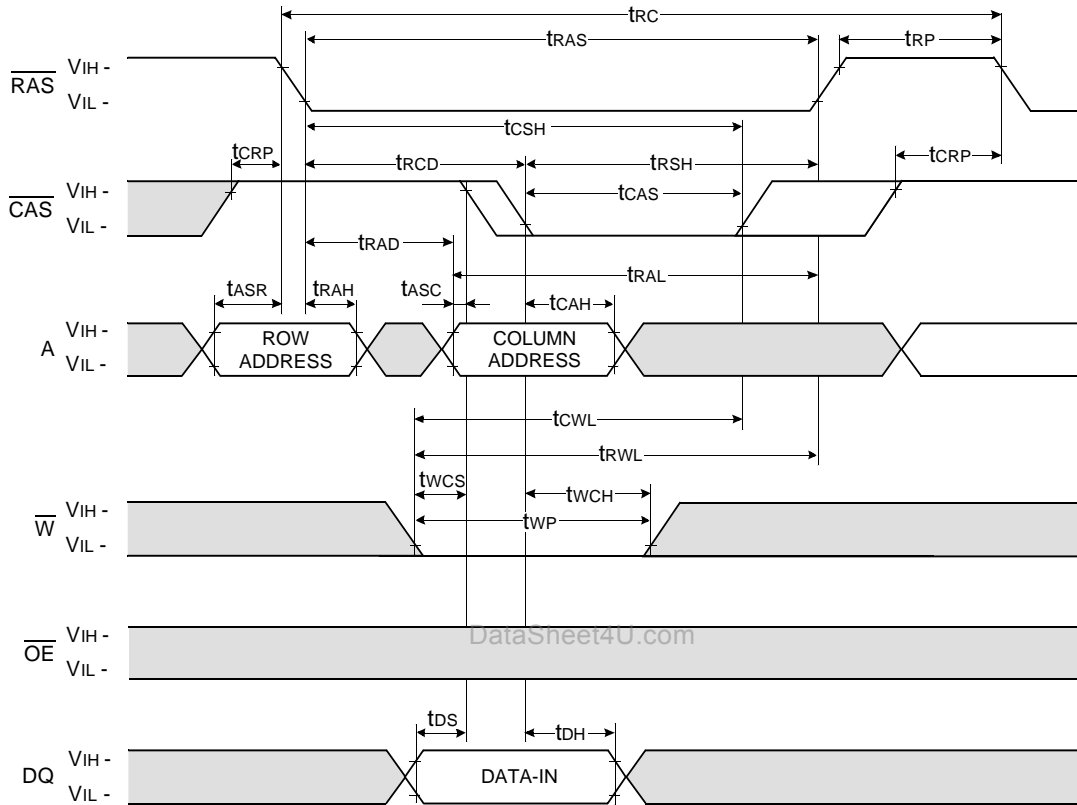








**DRAM MODULE****M53230404BY0/BT0-C****WRITE CYCLE ( EARLY WRITE )**

NOTE : DOUT = OPEN



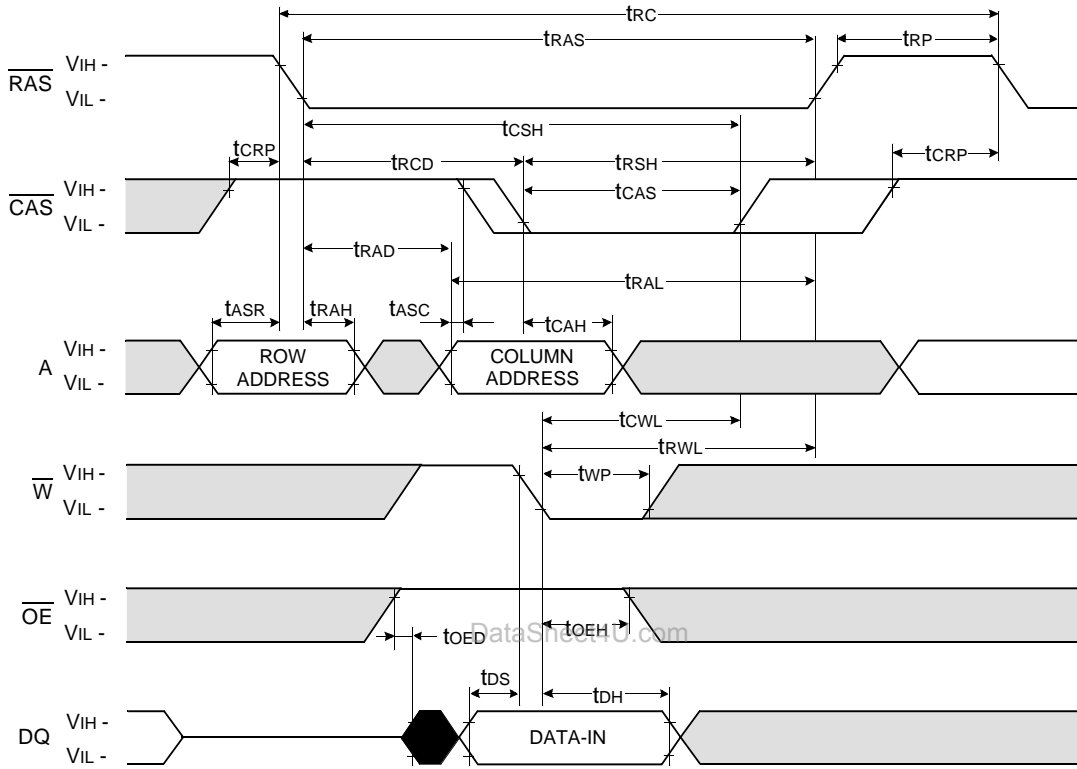
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# DRAM MODULE

# M53230404BY0/BT0-C

## WRITE CYCLE ( $\overline{OE}$ CONTROLLED WRITE )

NOTE : DOUT = OPEN



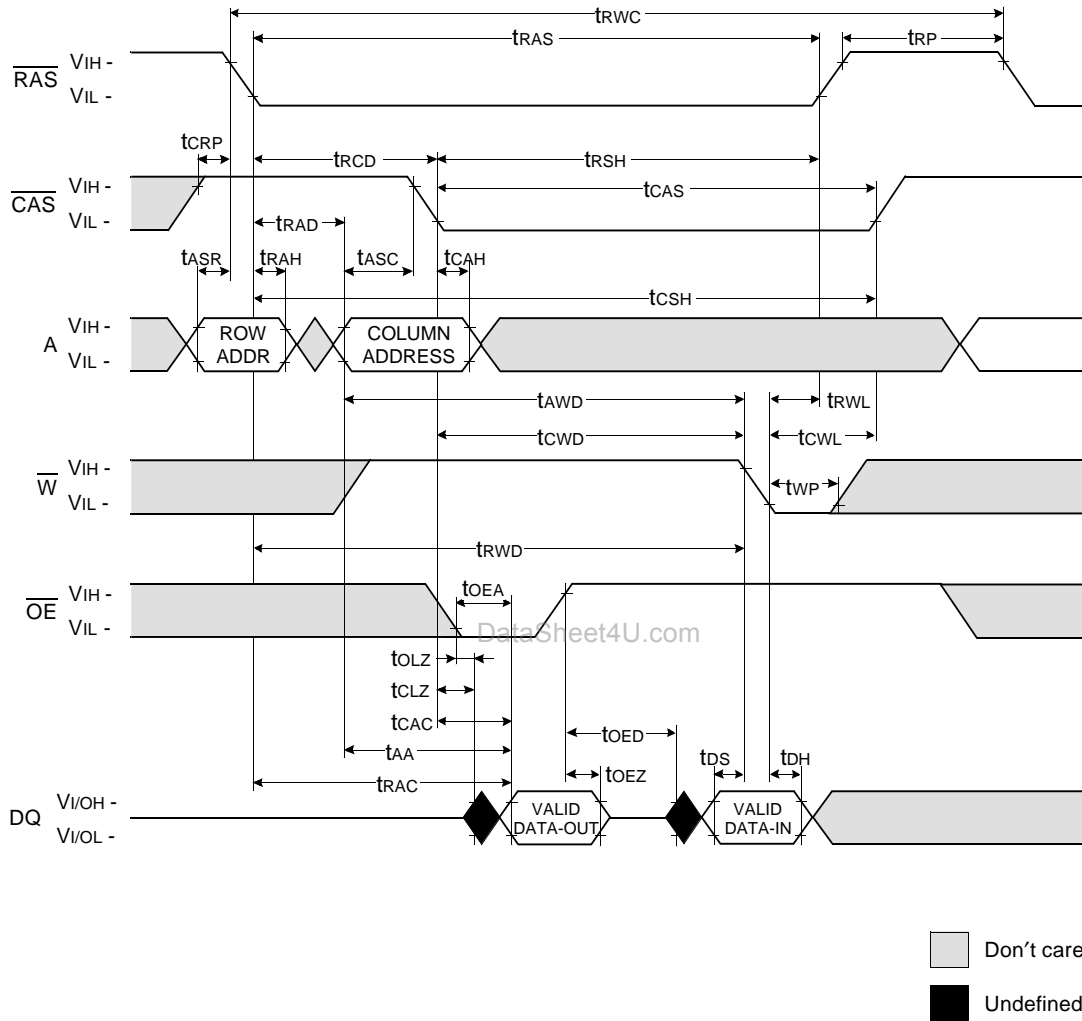
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# DRAM MODULE

# M53230404BY0/BT0-C

## READ - MODIFY - WRITE CYCLE



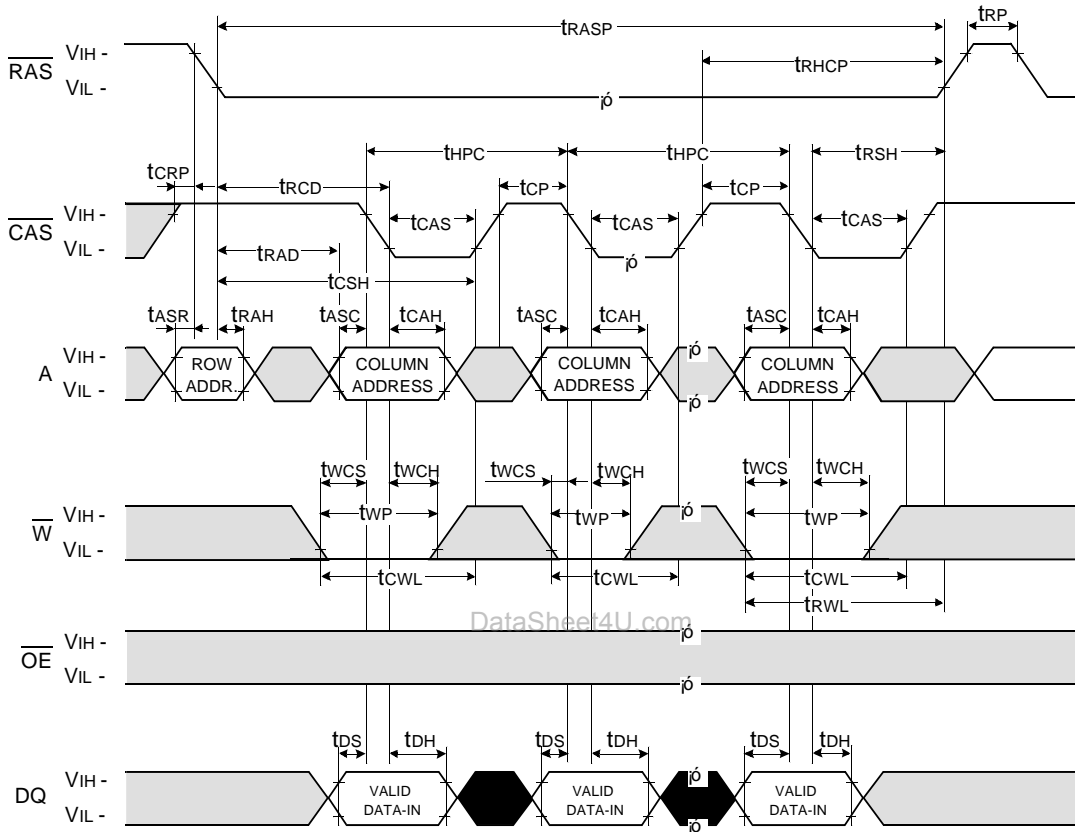


# DRAM MODULE

# M53230404BY0/BT0-C

## HYPER PAGE WRITE CYCLE ( EARLY WRITE )

NOTE : DOUT = OPEN



Don't care  
 Undefined

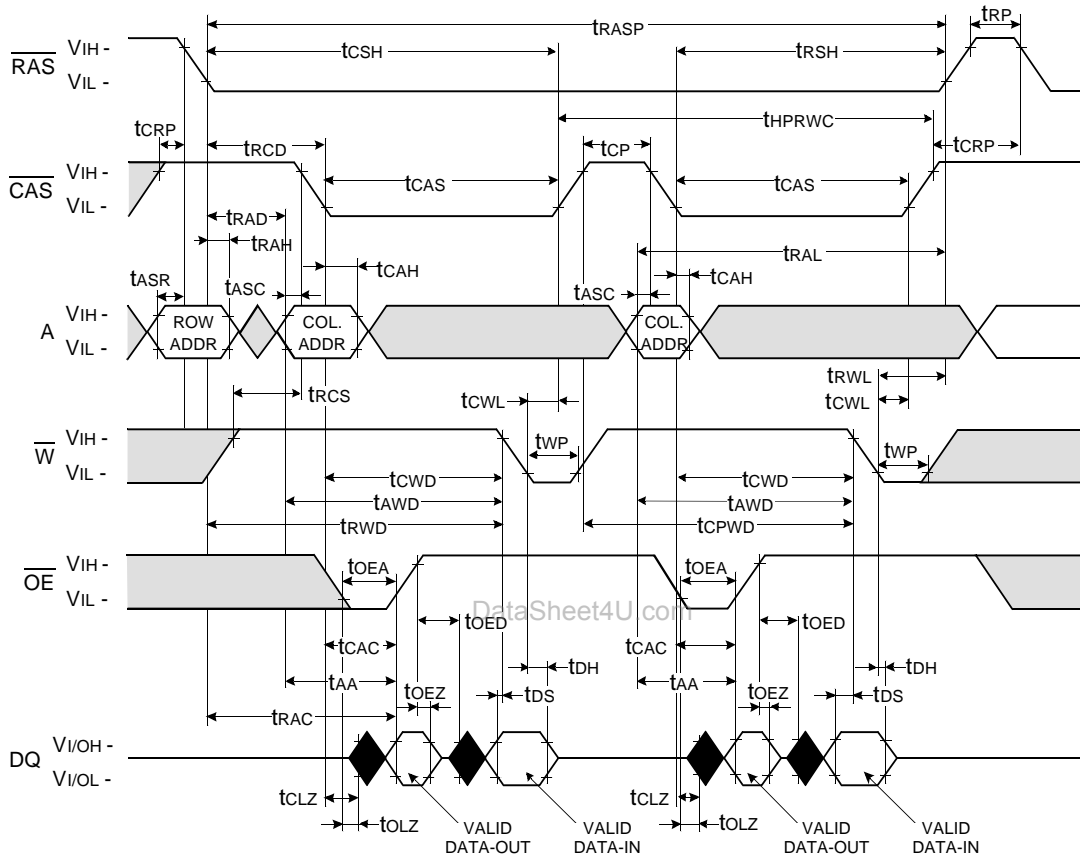


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# DRAM MODULE

# M53230404BY0/BT0-C

## HYPER PAGE READ-MODIFY-WRITE CYCLE



Don't care  
 Undefined





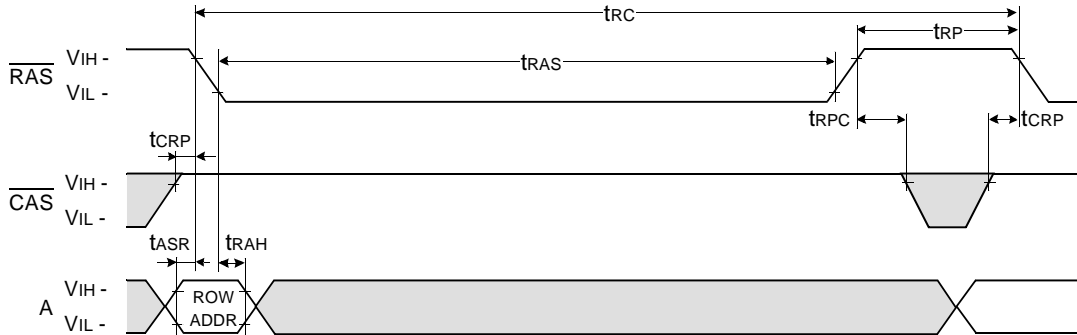
# DRAM MODULE

# M53230404BY0/BT0-C

## RAS - ONLY REFRESH CYCLE\*

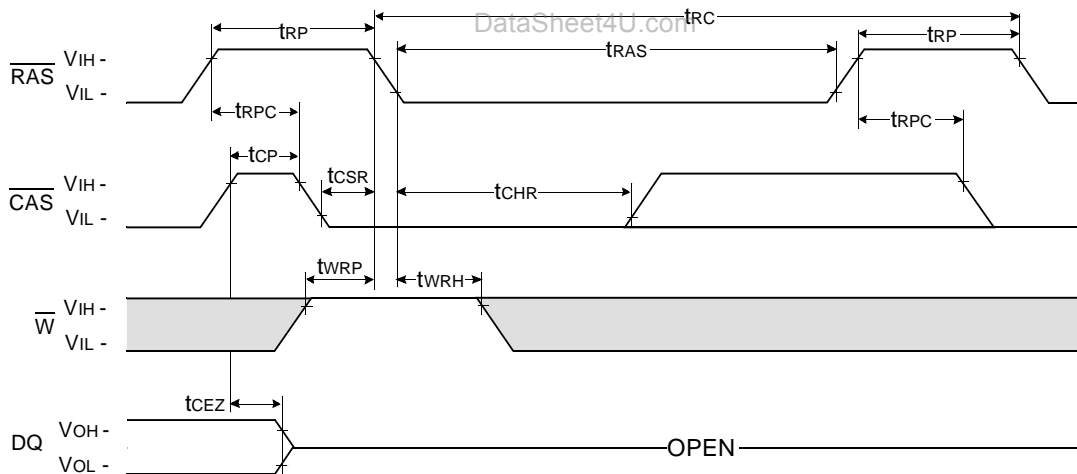
NOTE :  $\overline{W}$ ,  $\overline{OE}$ , DIN = Don't care

DOUT = OPEN



## CAS - BEFORE - RAS REFRESH CYCLE

NOTE :  $\overline{OE}$ , A = Don't care



Don't care  
 Undefined

\* In RAS-only refresh cycle of 64Mb A-die & B-die, when  $\overline{CAS}$  signal transits from Low to High, the valid data may be cut off.

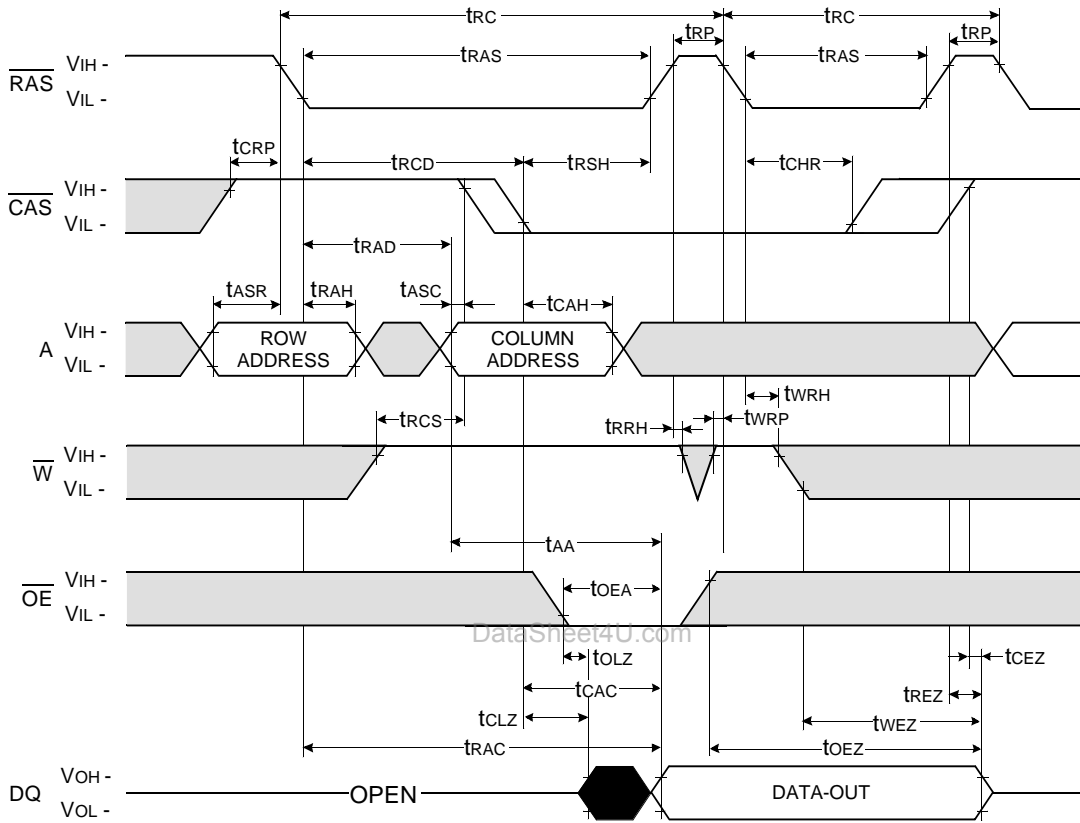




# DRAM MODULE

# M53230404BY0/BT0-C

## HIDDEN REFRESH CYCLE ( READ )



Don't care  
 Undefined

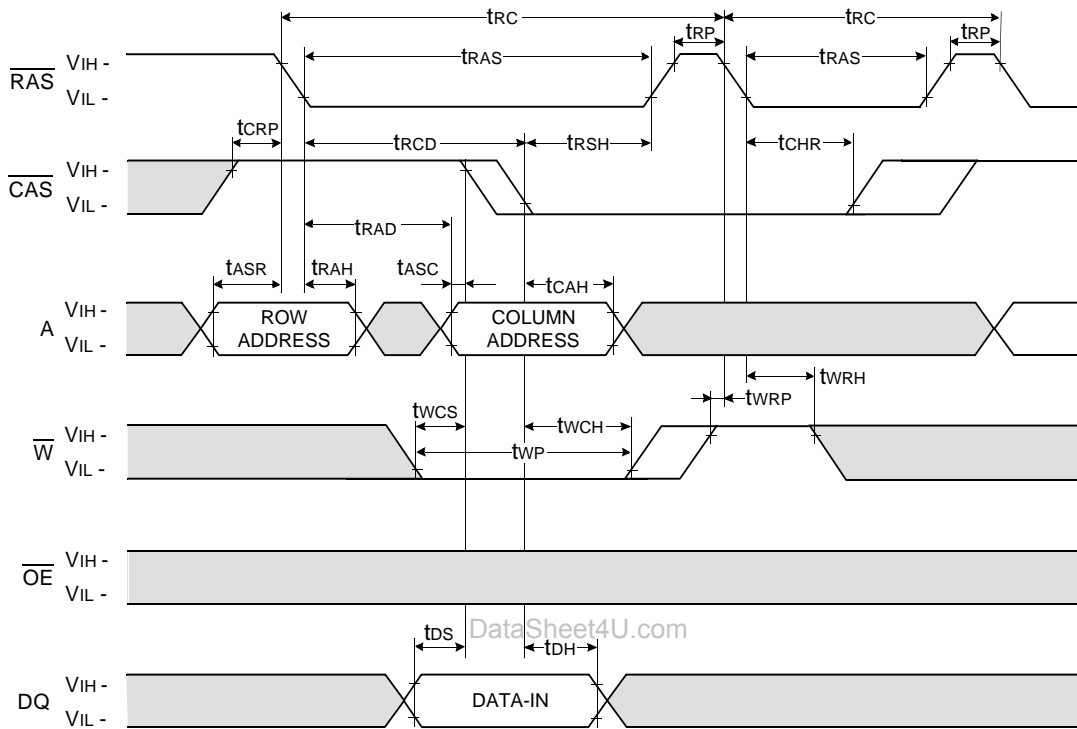


# DRAM MODULE

# M53230404BY0/BT0-C

## HIDDEN REFRESH CYCLE ( WRITE )

NOTE : DOUT = OPEN



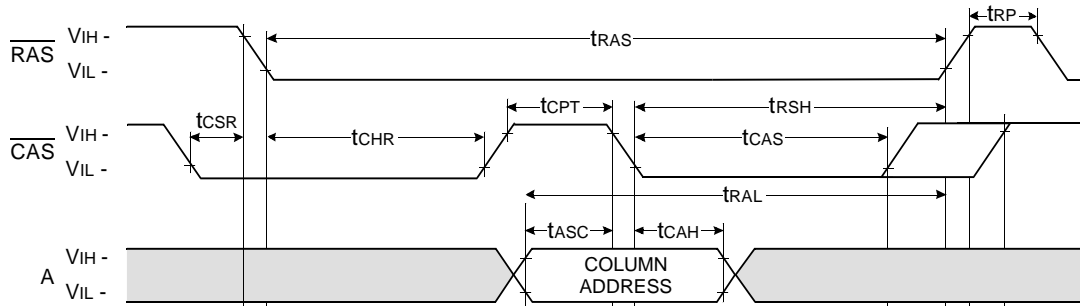
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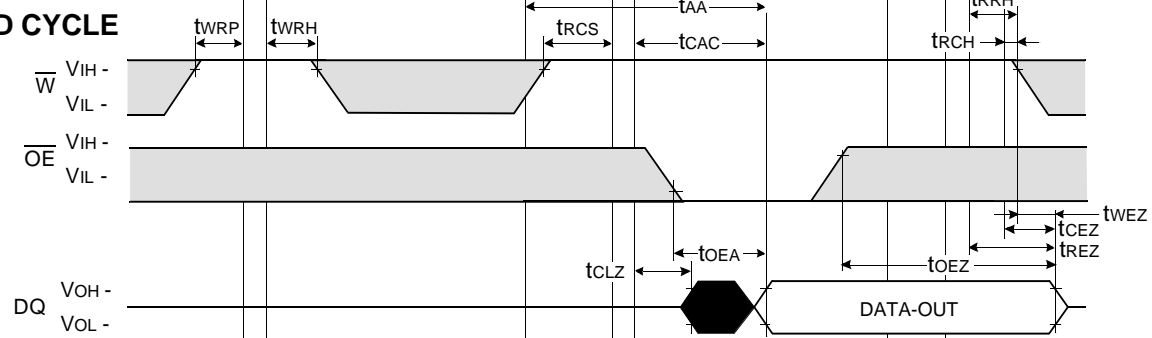
# DRAM MODULE

# M53230404BY0/BT0-C

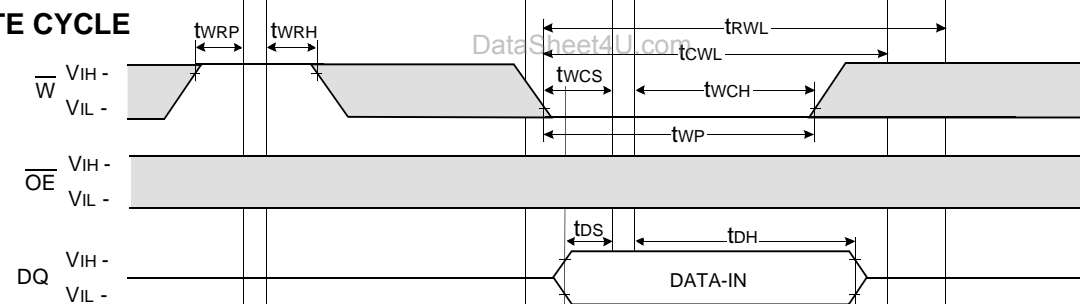
## CAS-BEFORE-RAS REFRESH CYCLE TEST CYCLE



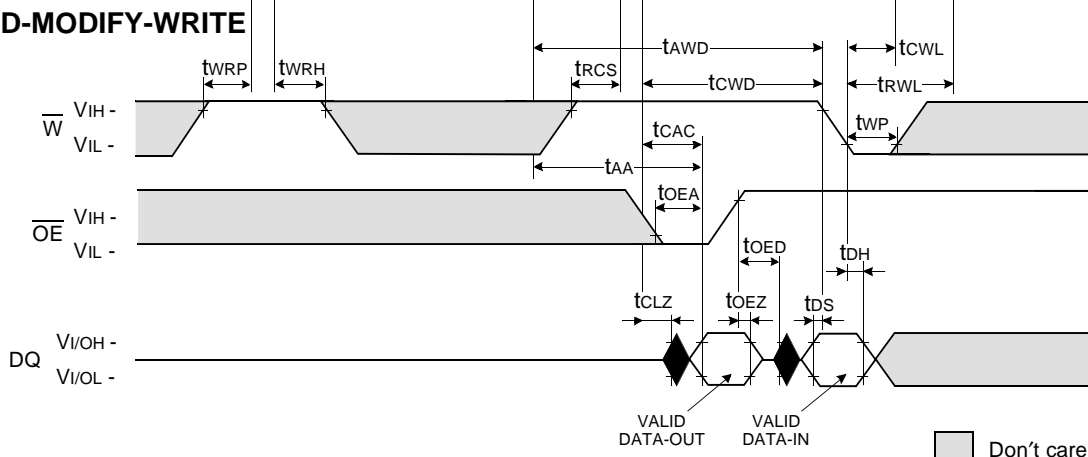
## READ CYCLE



## WRITE CYCLE



## READ-MODIFY-WRITE



Don't care  
 Undefined

NOTE : This timing diagram is applied to all devices besides 64M DRAM based modules.

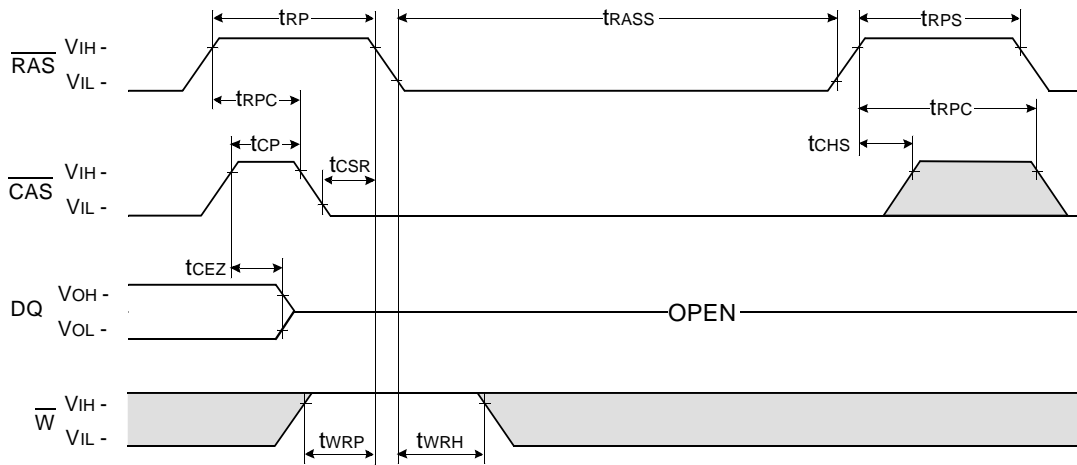


# DRAM MODULE

# M53230404BY0/BT0-C

## CAS - BEFORE - RAS SELF REFRESH CYCLE

NOTE :  $\overline{OE}$ , A = Don't care

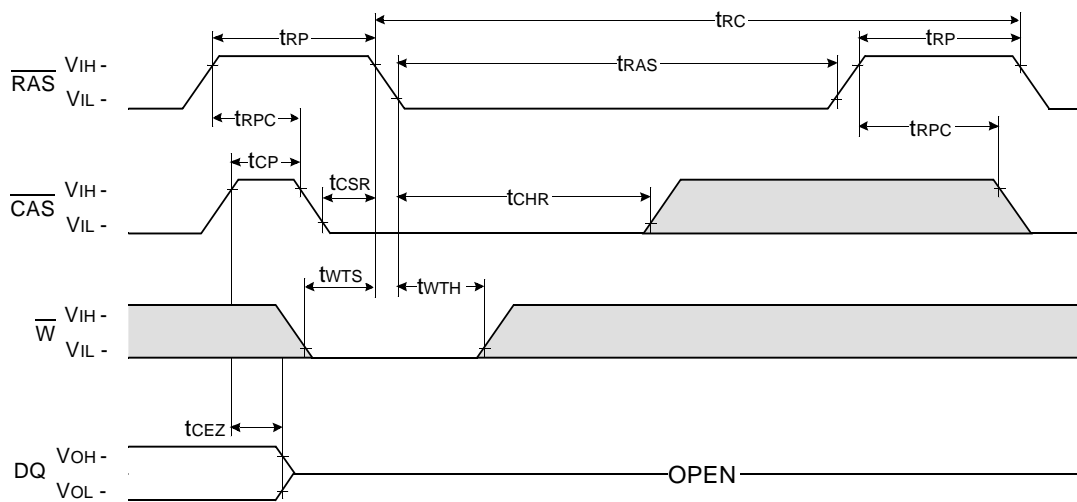


## TEST MODE IN CYCLE

NOTE :  $\overline{OE}$ , A = Don't care

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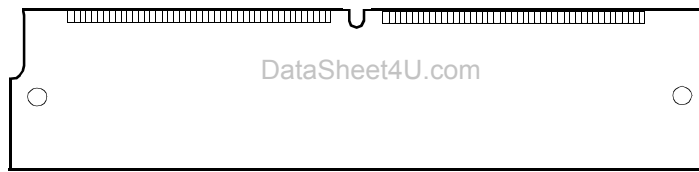
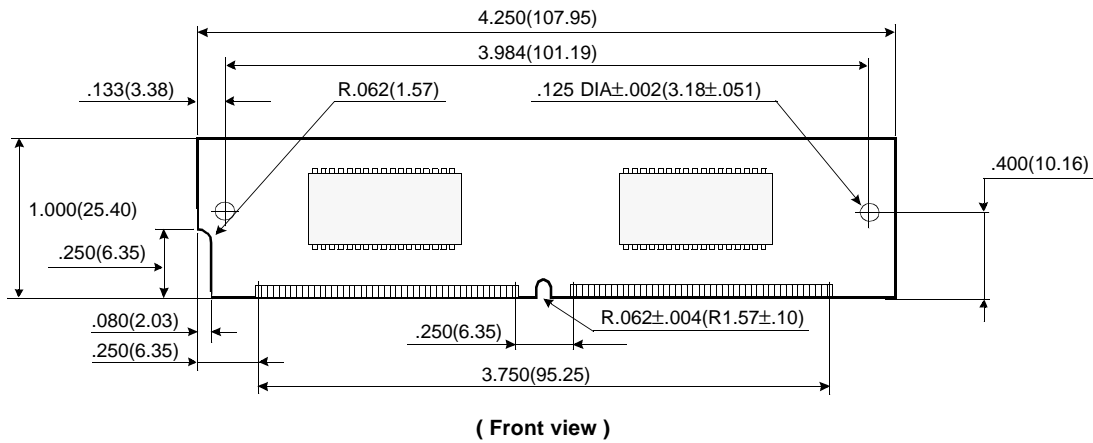


# DRAM MODULE

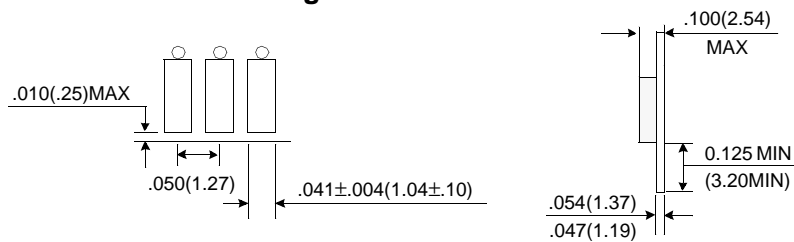
# M53230404BY0/BT0-C

## PACKAGE DIMENSIONS

Units : Inches (millimeters)



### Gold/Solder Plating Lead



Tolerances :  $\pm .005(.13)$  unless otherwise specified

NOTE : The used device is 4Mx16 DRAM, TSOPII  
 DRAM Part No. : M53230404BY0/BT0 -- K4E641611B (400 mil)

