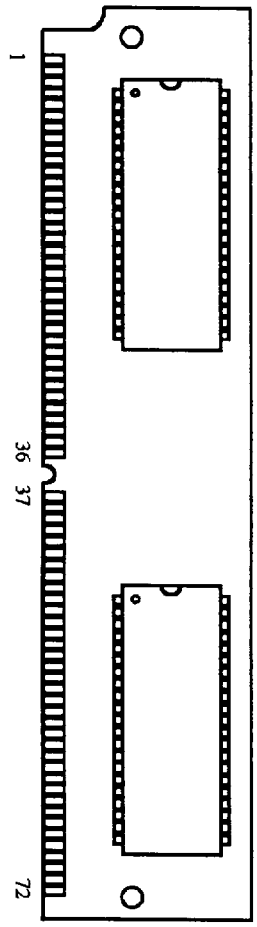
Description

The GMM7321000BNS/SG is an 1M x 32 bits Dynamic RAM MODULE which is assembled 2 pieces of 1M x 16bit DRAMs in 42 pin SOJ package on single sides the printed circuit board with decoupling capacitors. The GMM7321000BNS/SG is optimized for application to the systems which are required high density and large capacity such as main memory of the computers and an image memory systems, and to the others which are requested compact size. The GMM7321000BNS/SG provides common data inputs and outputs.

• **GMM7321000BNS/SG** (Single Side)



Features

- 72 pins Single In-Line Package
  - GMM7321000BNS : Solder plating
  - GMM7321000BNSG : Gold plating
- Fast Page Mode Capability
- Single Power Supply
- Fast Access Time & Cycle Time

(Unit: ns)

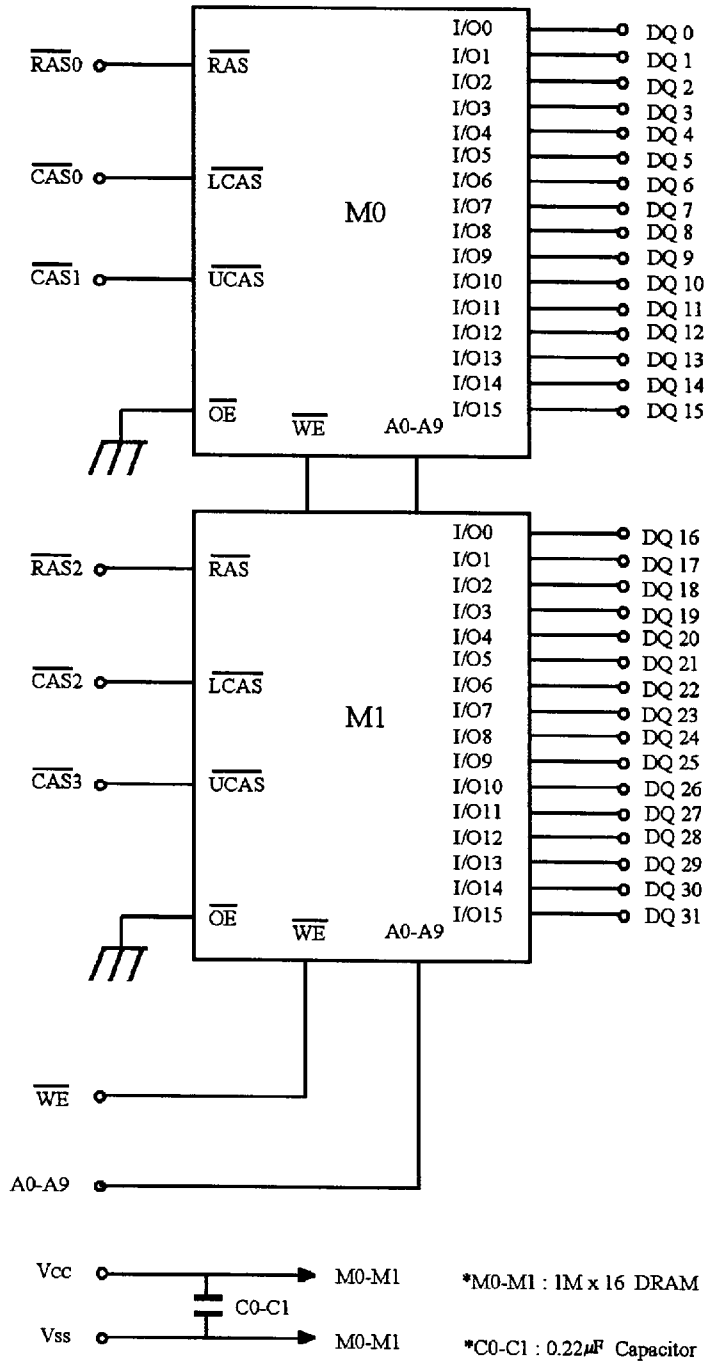
	t_{RAC}	t_{CAC}	t_{RC}	t_{PC}
GMM7321000BNS/SG-60	60	15	110	40
GMM7321000BNS/SG-70	70	18	130	45
GMM7321000BNS/SG-80	80	20	150	50

- Low Power
  Active : 1,870/1,650/1,430 mW (MAX)
  Standby : 11mW (CMOS level : MAX)
- $\overline{RAS}$ Only Refresh, $\overline{CAS}$ before $\overline{RAS}$ Refresh, Hidden Refresh Capability
- All inputs and outputs TTL Compatible
- 1024 Refresh Cycles/16ms

Pin Configuration (Top View)

Pin	Symbol	Pin	Symbol	Pin	Symbol	Pin	Symbol
1	V_{SS}	19	NC	37	NC	55	DQ_{11}
2	DQ_0	20	DQ_4	38	NC	56	DQ_{27}
3	DQ_{16}	21	DQ_{20}	39	V_{SS}	57	DQ_{12}
4	DQ_1	22	DQ_5	40	$\overline{CAS_0}$	58	DQ_{28}
5	DQ_{17}	23	DQ_{21}	41	$\overline{CAS_2}$	59	V_{CC}
6	DQ_2	24	DQ_6	42	$\overline{CAS_3}$	60	DQ_{29}
7	DQ_{18}	25	DQ_{22}	43	$\overline{CAS_1}$	61	DQ_{13}
8	DQ_3	26	DQ_7	44	$\overline{RAS_0}$	62	DQ_{30}
9	DQ_{19}	27	DQ_{23}	45	NC	63	DQ_{14}
10	V_{CC}	28	A_7	46	NC	64	DQ_{31}
11	NC	29	NC	47	$\overline{WE}$	65	DQ_{15}
12	A_0	30	V_{CC}	48	NC	66	NC
13	A_1	31	A_8	49	DQ_8	67	PD_1
14	A_2	32	A_9	50	DQ_{24}	68	PD_2
15	A_3	33	NC	51	DQ_9	69	PD_3
16	A_4	34	$\overline{RAS_2}$	52	DQ_{25}	70	PD_4
17	A_5	35	NC	53	DQ_{10}	71	NC
18	A_6	36	NC	54	DQ_{26}	72	V_{SS}

Block Diagram



*M0-M1 : 1M x 16 DRAM

*C0-C1 : 0.22μF Capacitor

Pin Description

Pin	Function	Pin	Function
A0-A9	Address Inputs	PD1-PD4	Presence Detect
DQ0-DQ31	Data Input/Output	Vcc	Power (+5V)
$\overline{RAS0}$,$\overline{RAS2}$	Row Address Strobe	Vss	Ground
$\overline{CAS0}$-$\overline{CAS3}$	Column Address Strobe	NC	No Connection
$\overline{WE}$	Read/Write Enable		

Presence Detect Pins (Optional)

Pin	60ns	70ns	80ns
PD1	Vss	Vss	Vss
PD2	Vss	Vss	Vss
PD3	NC	Vss	NC
PD4	NC	NC	Vss

Absolute Maximum Ratings*

Symbol	Parameter	Rating	Unit
T_A	Ambient Temperature under Bias	0 ~ 70	℃
T_{STG}	Storage Temperature (Plastic)	-55 ~ 125	℃
V_{IN}/V_{OUT}	Voltage on any Pin Relative to Vss	-1.0 ~ 7.0	V
V_{CC}	Power Supply Voltage	-1.0 ~ 7.0	V
I_{OUT}	Short Circuit Output Current	50	mA
P_D	Power Dissipation	2	W

*Note: 1. Stress greater than above "Absolute Maximum Ratings" may cause permanent damage to the device.

Recommended DC Operating Conditions ($T_A = 0 \sim 70℃$)

Symbol	Parameter	Min	Typ	Max	Unit	Note
V_{CC}	Supply Voltage	4.5	5.0	5.5	V	1
V_{IH}	Input High Voltage	2.4	-	6.5	V	1
V_{IL}	Input Low Voltage	-1.0	-	0.8	V	1

*Note: 1. All voltages referenced to Vss.

DC Electrical Characteristics (V_{CC} = 5V ± 10%, T_A = 0 ~ 70℃)

Symbol	Parameter		Min	Max	Unit	Note
V_{OH}	Output Level Output "H" Level Voltage (I_{OUT} = -5mA)		2.4	V_{CC}	V	
V_{OL}	Output Level Output "L" Level Voltage (I_{OUT} = 4.2mA)		0	0.4	V	
I_{CC1}	Operating Current Average Power Supply Operating Current ($\overline{RAS}$, $\overline{CAS}$, Address Cycling: t_{RC} = t_{RC} min)	60ns	-	340	mA	1, 2
		70ns	-	300		
		80ns	-	260		
I_{CC2}	Standby Current (TTL) Power Supply Standby Current ($\overline{RAS}$, $\overline{CAS}$ = V_{IH})		-	4	mA	
I_{CC3}	$\overline{RAS}$ Only Refresh Current Average Power Supply Current $\overline{RAS}$ Only Mode ($\overline{RAS}$ Cycling, $\overline{CAS}$ = V_{IH}, t_{RC} = t_{RC} min)	60ns	-	340	mA	2
		70ns	-	300		
		80ns	-	260		
I_{CC4}	Fast Page Mode Current Average Power Supply Current Fast Page Mode ($\overline{RAS}$ = V_{IL}, $\overline{CAS}$, Address Cycling: t_{PC} = t_{PC} min)	60ns	-	340	mA	1, 3
		70ns	-	300		
		80ns	-	260		
I_{CC5}	Standby Current (CMOS) Power Supply Standby Current ($\overline{RAS}$, $\overline{CAS}$ ≥ V_{CC}-0.2V)		-	2	mA	
I_{CC6}	$\overline{CAS}$ before $\overline{RAS}$ Refresh Current (t_{RC} = t_{RC} min)	60ns	-	340	mA	
		70ns	-	300		
		80ns	-	260		
I_{CC7}	Standby Current $\overline{RAS}$ = V_{IH} $\overline{CAS}$ = V_{IL} D_{OUT} = Enable		-	10	mA	1
$I_{I(L)}$	Input Leakage Current Any Input (0V ≤ V_{IN} ≤ 7V) All Other Pins Not Under Test = 0V		-10	10	μA	
$I_{O(L)}$	Output Leakage Current (D_{OUT} is Disabled, 0V ≤ V_{OUT} ≤ 7V)		-10	10	μA	

Note: 1. Icc depends on output load condition when the device is selected. Icc(max) is specified at the output open condition.
2. Address can be changed once or less while $\overline{RAS}$ = V_{IL}.
3. Address can be changed once or less while $\overline{CAS}$ = V_{IH}.

Capacitance (V_{CC} = 5V ± 10%, T_A = 25℃, f = 1MHz)

Symbol	Parameter	Min	Max	Unit	Note
C_{I1}	Input Capacitance (A0~A9)	-	35	pF	1
C_{I2}	Input Capacitance ($\overline{WE}$)	-	34	pF	1, 2
C_{I3}	Input Capacitance ($\overline{RAS0}$,$\overline{RAS2}$)	-	27	pF	1, 2
C_{I4}	Input Capacitance ($\overline{CAS0}$~$\overline{CAS3}$)	-	27	pF	1, 2
$C_{I/O}$	I/O Capacitance (DQ0~DQ31)	-	20	pF	1, 2

Note: 1. Capacitance measured with Boonton Meter or effective capacitance measuring method.
2. $\overline{CAS}$ = V_{IH} to disable D_{OUT}.

AC Electrical Characteristics (V_{CC} = 5V ± 10%, T_A = 0 ~ 70℃, Notes 1, 15)

The GMM7321000BNS/SG writes data only in early write cycle ($t_{WCS} \geq t_{WCS(min)}$).
Delayed write cycle is not available because of I/O common.

Read, Write and Refresh Cycle (Common Parameters)

Symbol	Parameter	GMM7321000 BNS/SG-60		GMM7321000 BNS/SG-70		GMM7321000 BNS/SG-80		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{RC}	Random Read or Write Cycle Time	110	-	130	-	150	-	ns	
t_{RP}	$\overline{RAS}$ Precharge Time	40	-	50	-	60	-	ns	
t_{RAS}	$\overline{RAS}$ Pulse Width	60	10,000	70	10,000	80	10,000	ns	
t_{CAS}	$\overline{CAS}$ Pulse Width	15	10,000	18	10,000	20	10,000	ns	
t_{ASR}	Row Address Setup Time	0	-	0	-	0	-	ns	
t_{RAH}	Row Address Hold Time	10	-	10	-	10	-	ns	
t_{ASC}	Column Address Setup Time	0	-	0	-	0	-	ns	
t_{CAH}	Column Address Hold Time	10	-	15	-	15	-	ns	
t_{RCD}	$\overline{RAS}$ to $\overline{CAS}$ Delay Time	20	45	20	52	20	60	ns	9
t_{RAD}	$\overline{RAS}$ to Column Address Delay Time	15	30	15	35	15	40	ns	10
t_{RSH}	$\overline{RAS}$ Hold Time	15	-	18	-	20	-	ns	
t_{CSH}	$\overline{CAS}$ Hold Time	60	-	70	-	80	-	ns	
t_{CRP}	$\overline{CAS}$ to $\overline{RAS}$ Precharge Time	5	-	5	-	5	-	ns	
t_T	Transition Time (Rise and Fall)	3	50	3	50	3	50	ns	8
t_{REF}	Refresh Period (1024 Cycles)	-	16	-	16	-	16	ms	

Read Cycle

Symbol	Parameter	GMM7321000 BNS/SG-60		GMM7321000 BNS/SG-70		GMM7321000 BNS/SG-80		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{RAC}	Access Time from $\overline{RAS}$	-	60	-	70	-	80	ns	2, 3
t_{CAC}	Access Time from $\overline{CAS}$	-	15	-	18	-	20	ns	3, 4
t_{AA}	Access Time from Column Address	-	30	-	35	-	40	ns	3, 5, 14
t_{RCS}	Read Command Setup Time	0	-	0	-	0	-	ns	
t_{RCH}	Read Command Hold Time to $\overline{CAS}$	0	-	0	-	0	-	ns	6
t_{RRH}	Read Command Hold Time to $\overline{RAS}$	0	-	0	-	0	-	ns	6
t_{RAL}	Column Address to $\overline{RAS}$ Lead Time	30	-	35	-	40	-	ns	
t_{OFF}	Output Buffer Turn-off Time	-	15	-	15	-	15	ns	7

Write Cycle

Symbol	Parameter	GMM7321000 BNS/SG-60		GMM7321000 BNS/SG-70		GMM7321000 BNS/SG-80		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{WCS}	Write Command Setup Time	0	-	0	-	0	-	ns	11
t_{WCH}	Write Command Hold Time	10	-	15	-	15	-	ns	
t_{WP}	Write Command Pulse Width	10	-	10	-	10	-	ns	
t_{RWL}	Write Command to $\overline{RAS}$ Lead Time	15	-	18	-	20	-	ns	
t_{CWL}	Write Command to $\overline{CAS}$ Lead Time	15	-	18	-	20	-	ns	
t_{DS}	Data-in Setup Time	0	-	0	-	0	-	ns	12
t_{DH}	Data-in Hold Time	10	-	15	-	15	-	ns	12

Refresh Cycle

Symbol	Parameter	GMM7321000 BNS/SG-60		GMM7321000 BNS/SG-70		GMM7321000 BNS/SG-80		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{CSR}	$\overline{CAS}$ Setup Time ($\overline{CAS}$-before-$\overline{RAS}$ Refresh Cycle)	10	-	10	-	10	-	ns	
t_{CHR}	$\overline{CAS}$ Hold Time ($\overline{CAS}$-before-$\overline{RAS}$ Refresh Cycle)	10	-	10	-	10	-	ns	
t_{RPC}	$\overline{RAS}$ Precharge to $\overline{CAS}$ Hold Time	5	-	5	-	5	-	ns	

Fast Page Mode Cycle

Symbol	Parameter	GMM7321000 BNS/SG-60		GMM7321000 BNS/SG-70		GMM7321000 BNS/SG-80		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{PC}	Fast Page Mode Cycle Time	40	-	45	-	50	-	ns	
t_{CP}	Fast Page Mode $\overline{CAS}$ Precharge Time	10	-	10	-	10	-	ns	
t_{RASP}	Fast Page Mode $\overline{RAS}$ Pulse Width	60	100,000	70	100,000	80	100,000	ns	13
t_{ACP}	Access Time from $\overline{CAS}$ Precharge	-	35	-	40	-	45	ns	14
t_{RHCP}	$\overline{RAS}$ Hold Time from $\overline{CAS}$ Precharge	35	-	40	-	45	-	ns	

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. Either t_{RCH} or t_{RRH} must be satisfied for a read cycles.
7. $t_{OFF}(max)$ defines the time at which the outputs achieve the open circuit condition and is not referenced to output voltage levels.
8. $V_{IH}(min)$ and $V_{IL}(max)$ are reference levels for measuring timing of input signals. Also, transition times are measured between V_{IH} and V_{IL}.
9. 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}.
10. 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}.
11. t_{WCS} is not restrictive operating parameter. It is 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.
12. These parameters are referenced to $\overline{CAS}$ leading edge in early write cycles.
13. t_{RASP} is defines $\overline{RAS}$ pulse width in Fast Page Mode cycles.
14. Access time is determined by the longer of t_{AA} or t_{CAC} or t_{ACP}.
15. An initial pause of 200μs is required after power up followed by a minimum of eight initialization cycles (any combination of cycles containing $\overline{RAS}$ clock such as $\overline{RAS}$ only refresh). If the internal refresh counter is used, a minimum of eight $\overline{CAS}$ before $\overline{RAS}$ refresh cycles are required.

Timing Waveforms

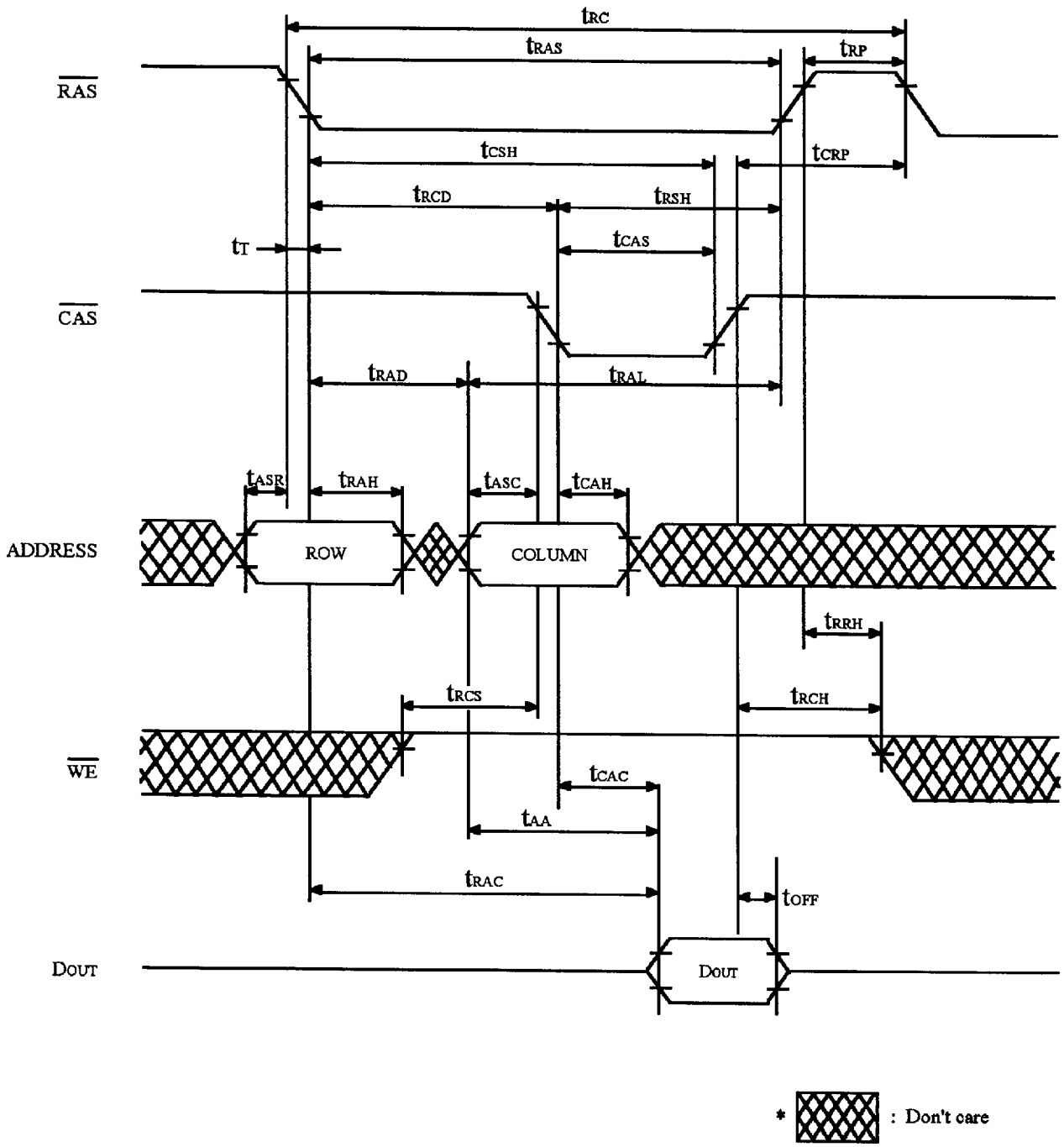


FIGURE 1. READ CYCLE

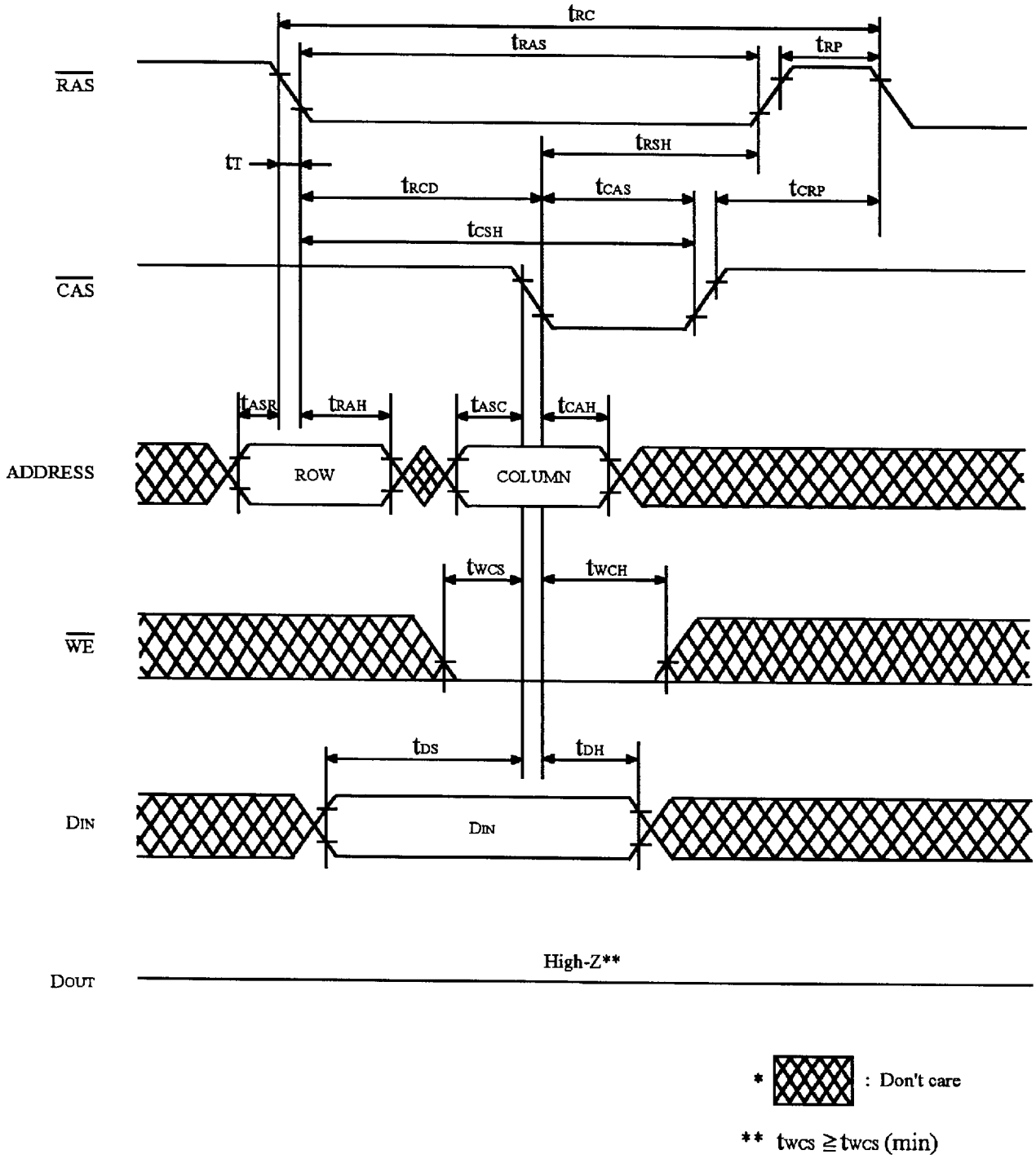
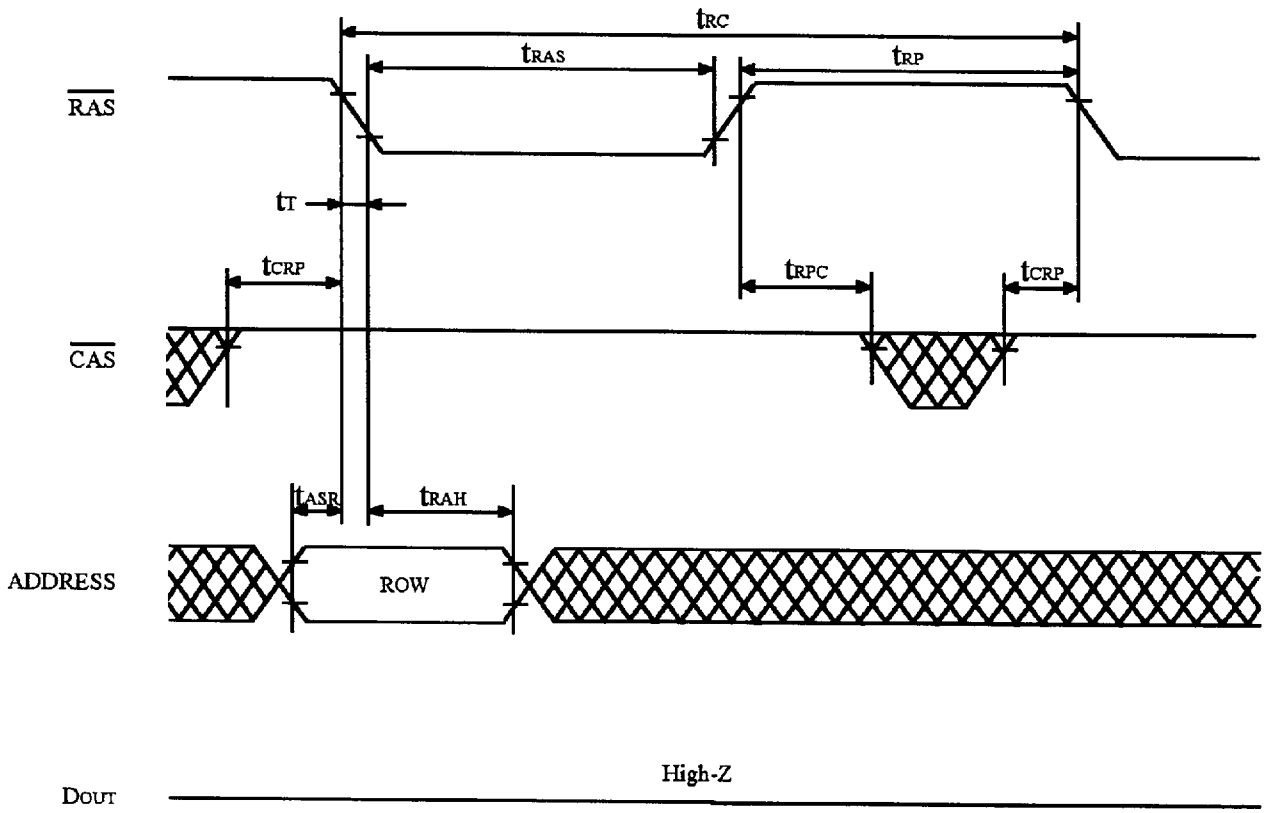


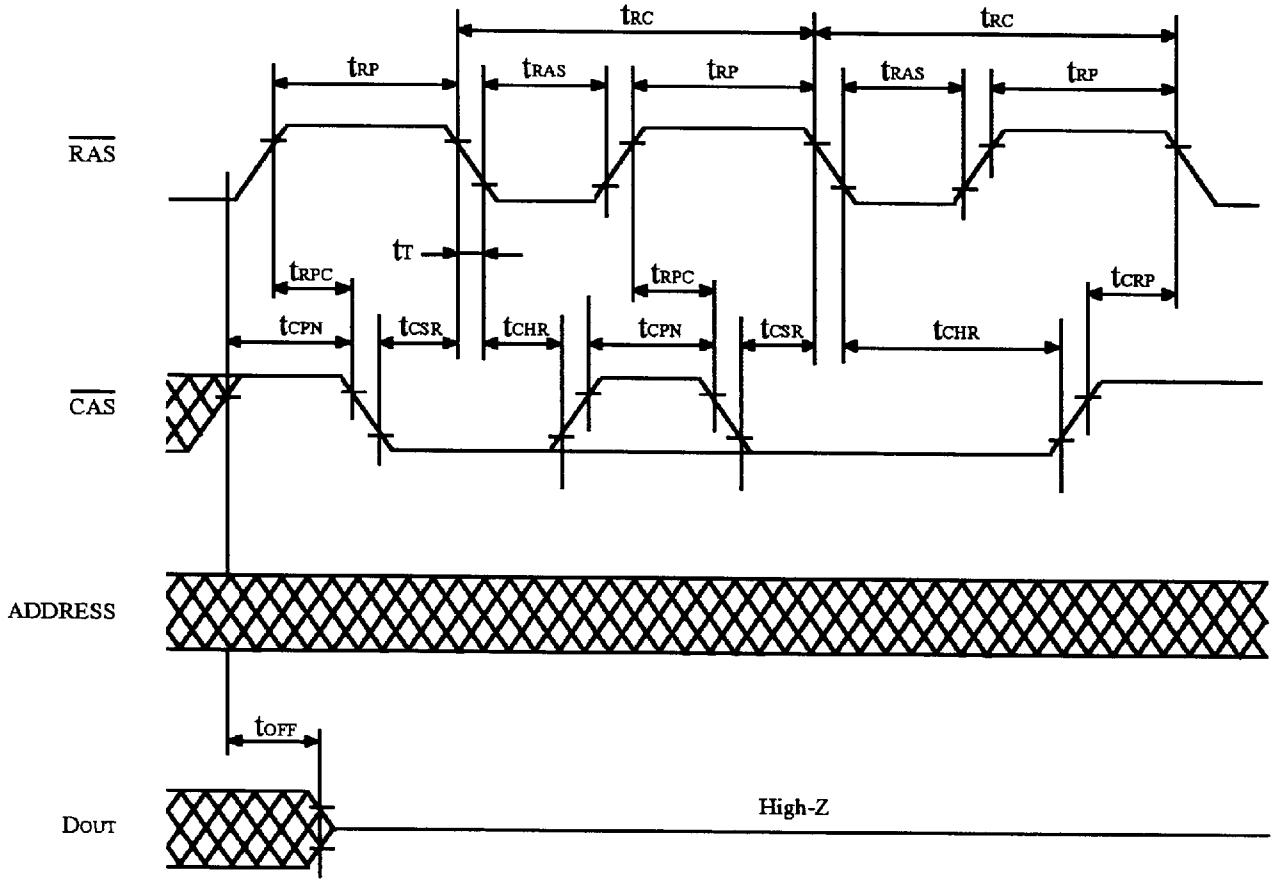
FIGURE 2. EARLY WRITE CYCLE



* : Don't care

** $\overline{WE}$: Don't care

FIGURE 3. $\overline{RAS}$ ONLY REFRESH CYCLE



* : Don't care

* * $\overline{WE}$: V_{IH}

FIGURE 4. $\overline{CAS}$ BEFORE $\overline{RAS}$ REFRESH CYCLE

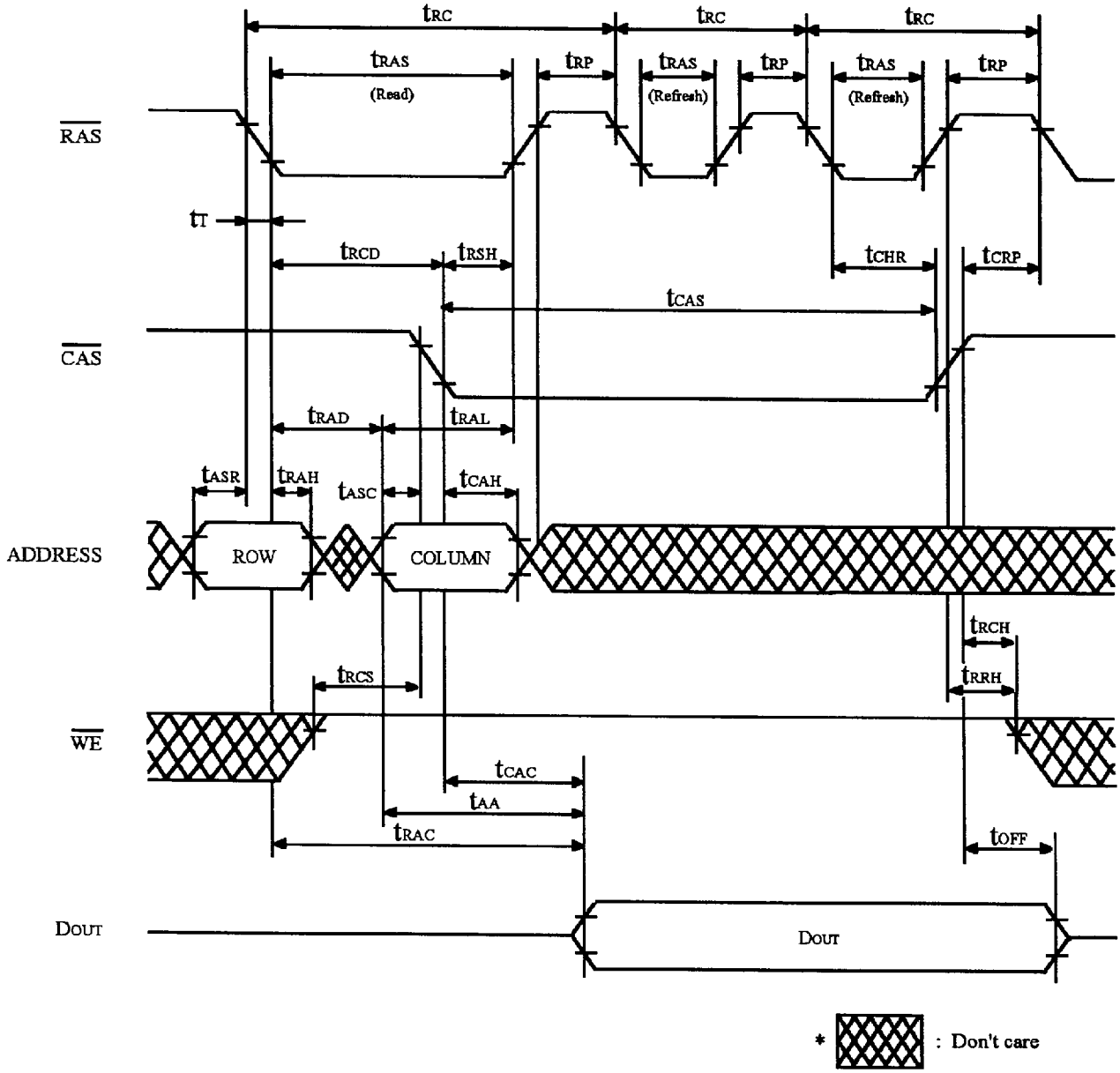


FIGURE 5. HIDDEN REFRESH CYCLE

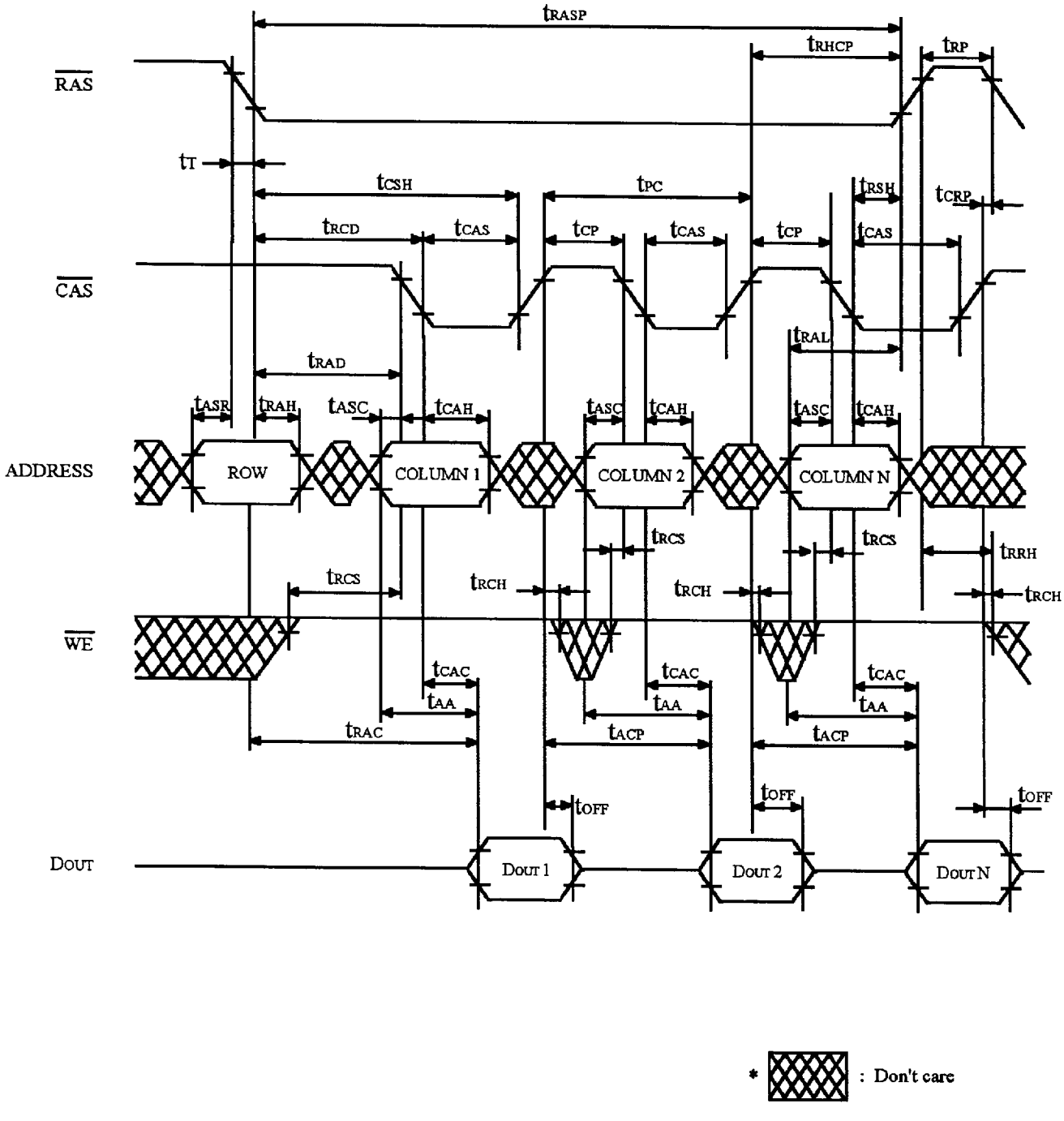


FIGURE 6. FAST PAGE MODE READ CYCLE

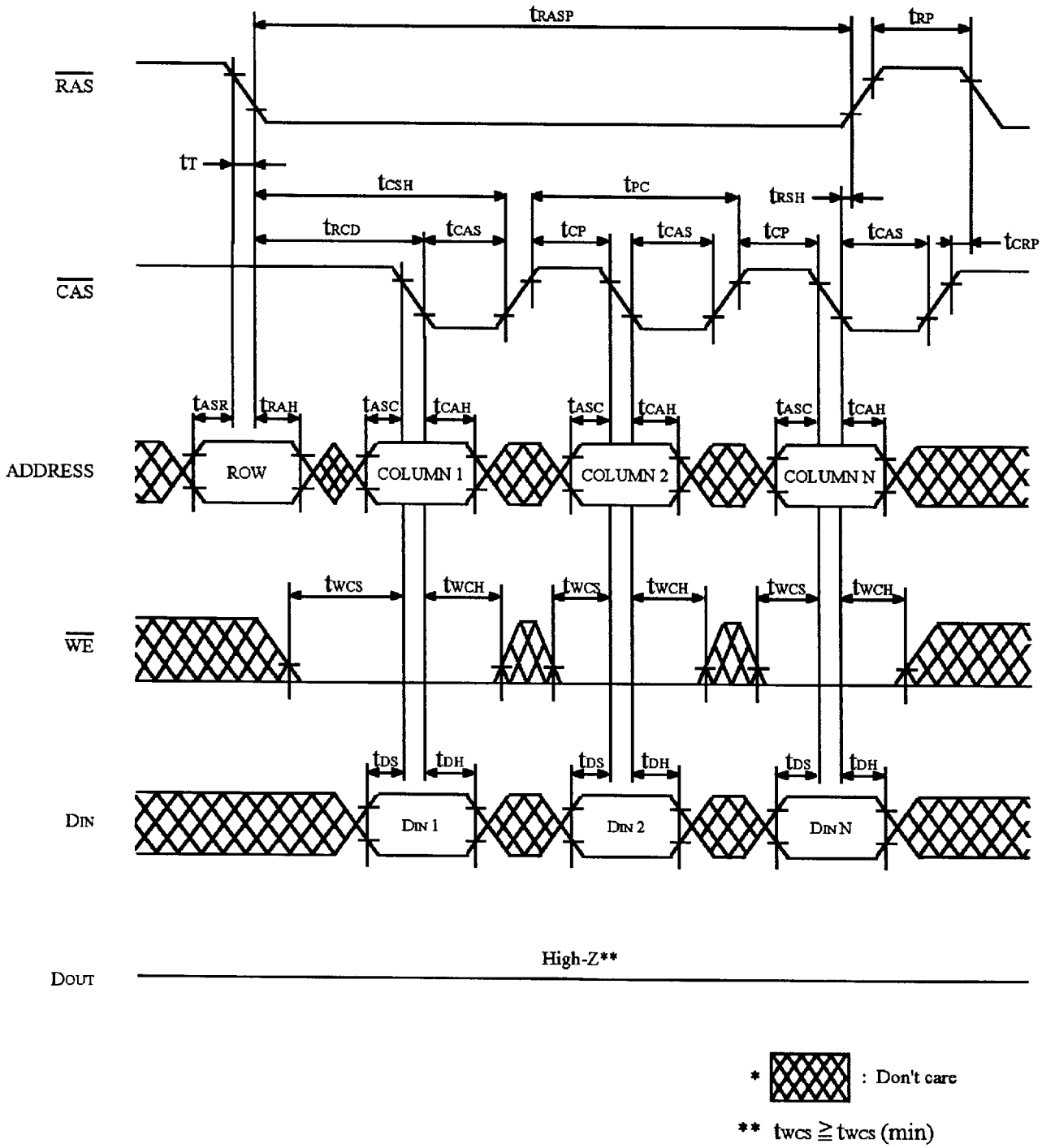
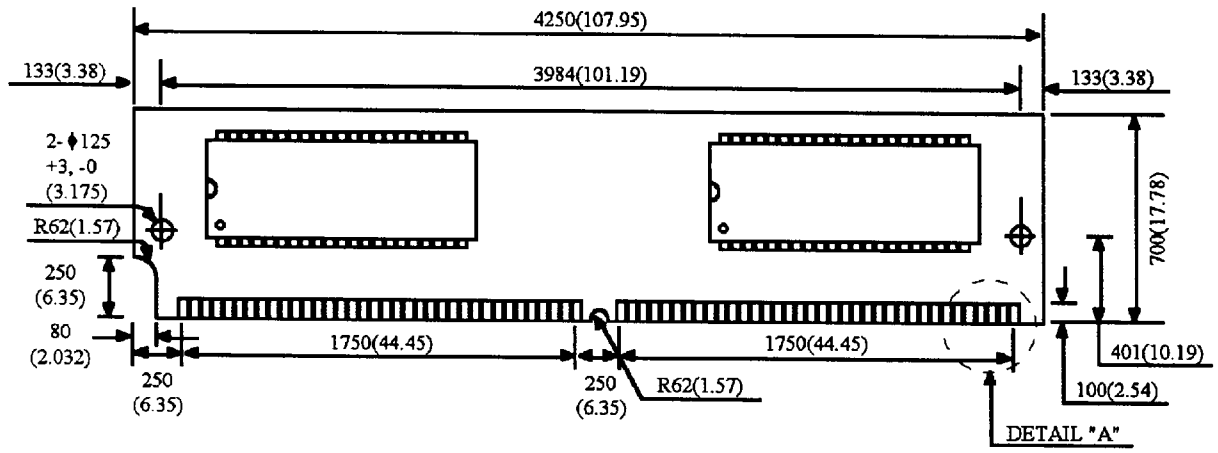


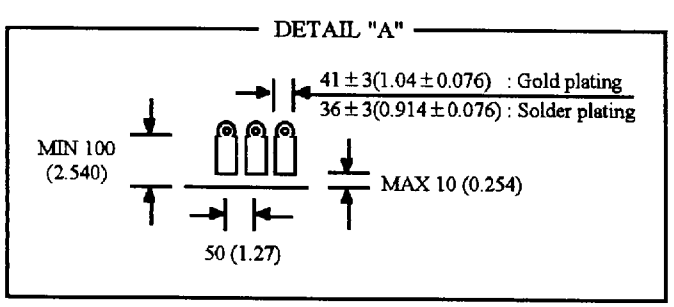
FIGURE 7. FAST PAGE MODE EARLY WRITE CYCLE

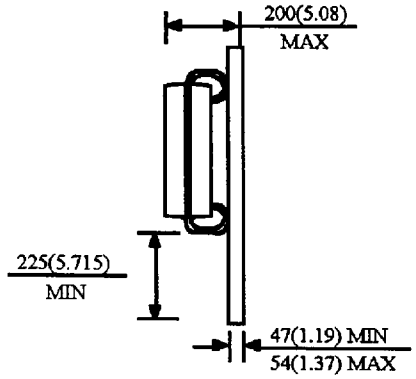
Package Dimension

Unit: mil (mm)

* (1mil = 1/1000 inches)







Tolerances : ± 5 (0.127) unless otherwise specified.