

Description

The GM71C4260A/AL is the new generation dynamic RAM organized 262,144 x 16 bit. GM71C4260A/AL has realized higher density, higher performance and various functions by utilizing advanced CMOS process technology. The GM71C4260A/AL offers Fast Page Mode as a high speed access mode. Multiplexed address inputs permit the GM71C4260A/AL to be packaged in standard 400 mil 40 pin plastic SOJ and standard 400 mil 40 pin plastic TSOP II. The package size provides high system bit densities and is compatible with widely available automated testing and insertion equipment. System oriented features include single power supply of 5V ± 10% tolerance, direct interfacing capability with high performance logic families such as Schottky TTL.

Features

- 262,144 Words x 16 Bit Organization
- Fast Page Mode Capability
- Single Power Supply (5V ± 10%)
- Fast Access Time & Cycle Time

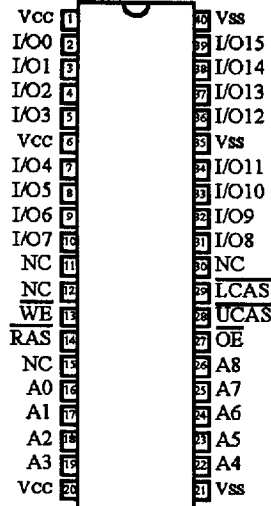
(Unit: ns)

	t _{TRAC}	t _{CAC}	t _{RC}	t _{PC}
GM71C4260A/AL-70	70	15	110	45
GM71C4260A/AL-80	80	20	130	50
GM71C4260A/AL-100	100	25	150	55

- Low Power
Active : 825/770/688mW (MAX)
Standby : 5.5mW (CMOS level : MAX)
1.1mW (L-series)
- $\overline{\text{RAS}}$ Only Refresh, $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ Refresh, Hidden Refresh Capability
- All inputs and outputs TTL Compatible
- 512 Refresh Cycles/8ms
- 512 Refresh Cycles/128ms (L-series)
- Battery Back Up Operation (L-series)
- 2 $\overline{\text{CAS}}$ byte Control
- Self-Refresh Operation (GM71CS4260A/AL)

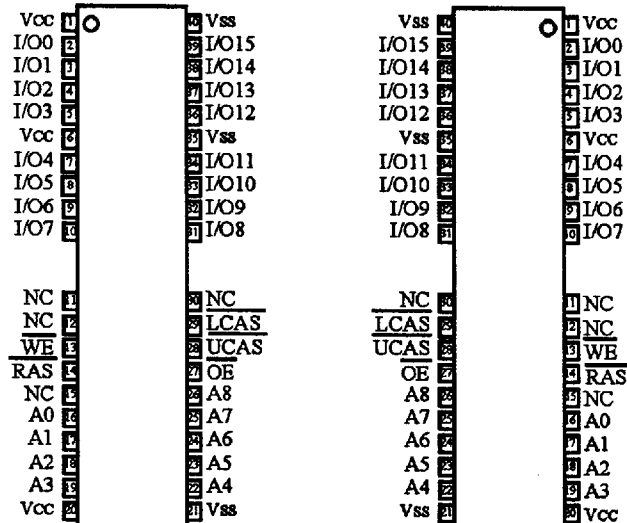
Pin Configuration

40 SOJ



(Top View)

40 (44) TSOP II



(Normal)

(Reverse)

(Top View)

Pin Description

Pin	Function	Pin	Function
A0-A8	Address Inputs	\overline{WE}	Read/Write Enable
A0-A8	Refresh Address Inputs	\overline{OE}	Output Enable
I/O0-I/O15	Data-In/Out	V _{cc}	Power (+5V)
\overline{RAS}	Row Address Strobe	V _{ss}	Ground
$\overline{UCAS}, \overline{LCAS}$	Column Address Strobe	NC	No Connection

Ordering Information

Type No.	Access Time	Package
GM71C4260AJ/ALJ-70 GM71C4260AJ/ALJ-80 GM71C4260AJ/ALJ-10	70 ns 80 ns 100 ns	400 Mil 40 Pin Plastic SOJ
GM71C4260AZ/ALZ-70 GM71C4260AZ/ALZ-80 GM71C4260AZ/ALZ-10	70 ns 80 ns 100 ns	475 Mil 40 Pin Plastic ZIP
GM71C4260AT/ALT-70 GM71C4260AT/ALT-80 GM71C4260AT/ALT-10	70 ns 80 ns 100 ns	400 Mil 40 (44) Pin Plastic TSOP II (Normal Type)
GM71C4260AR/ALR-70 GM71C4260AR/ALR-80 GM71C4260AR/ALR-10	70 ns 80 ns 100 ns	400 Mil 40 (44) Pin Plastic TSOP II (Reverse Type)
GM71CS4260AJ/ALJ-70 GM71CS4260AJ/ALJ-80 GM71CS4260AJ/ALJ-10	70 ns 80 ns 100 ns	400 Mil 40 Pin Plastic SOJ
GM71CS4260AZ/ALZ-70 GM71CS4260AZ/ALZ-80 GM71CS4260AZ/ALZ-10	70 ns 80 ns 100 ns	475 Mil 40 Pin Plastic ZIP
GM71CS4260AT/ALT-70 GM71CS4260AT/ALT-80 GM71CS4260AT/ALT-10	70 ns 80 ns 100 ns	400 Mil 40 (44) Pin Plastic TSOP II (Normal Type)
GM71CS4260AR/ALR-70 GM71CS4260AR/ALR-80 GM71CS4260AR/ALR-10	70 ns 80 ns 100 ns	400 Mil 40 (44) Pin Plastic TSOP II (Reverse Type)

Absolute Maximum Ratings*

Symbol	Parameter	Rating	Unit
T _A	Ambient Temperature under Bias	0 ~ 70	°C
T _{STG}	Storage Temperature (Plastic)	-55 ~ 125	°C
V _{IN} /V _{OUT}	Voltage on any Pin Relative to V _{SS}	-1.0 ~ 7.0	V
V _{CC}	Voltage on V _{CC} Relative to V _{SS}	-1.0 ~ 7.0	V
I _{OUT}	Short Circuit Output Current	50	mA
P _D	Power Dissipation	1.0	W

*Note: Operation at or above Absolute Maximum Ratings can adversely affect device reliability.

Recommended DC Operating Conditions (T_A = 0 ~ 70°C)

Symbol	Parameter	Min	Typ	Max	Unit
V _{CC}	Supply Voltage	4.5	5.0	5.5	V
V _{IH}	Input High Voltage	2.4	-	6.5	V
V _{IL}	Input Low Voltage (I/O Pin)	-1.0	-	0.8	V
V _{IL}	Input Low Voltage (Others)	-2.0	-	0.8	V

Truth Table

$\overline{\text{RAS}}$	$\overline{\text{LCAS}}$	$\overline{\text{UCAS}}$	$\overline{\text{WE}}$	$\overline{\text{OE}}$	I/O0-I/O7	I/O8-I/O15	Operation
H	H	H	H	H	High-Z	High-Z	Standby
L	H	H	H	H	High-Z	High-Z	Refresh
L	L	H	H	L	D _{OUT}	High-Z	Lower Byte Read
L	H	L	H	L	High-Z	D _{OUT}	Upper Byte Read
L	L	L	H	L	D _{OUT}	D _{OUT}	Word Read
L	L	H	L	H	D _{IN}	Don't Care	Lower Byte Write
L	H	L	L	H	Don't Care	D _{IN}	Upper Byte Write
L	L	L	L	H	D _{IN}	D _{IN}	Word Write
L	L	L	H	H	High-Z	High-Z	CBR Refresh or Self Refresh
H to L	L	H	-	-	High-Z	High-Z	
H to L	H	L	-	-	High-Z	High-Z	
H to L	L	L	-	-	High-Z	High-Z	

DC Electrical Characteristics ($V_{CC} = 5V \pm 10\%$, $T_A = 0 \sim 70^\circ C$)

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{LCAS} or \overline{UCAS} Cycling: $t_{RC} = t_{RC\ min}$)	70ns	-	150	mA	1, 2
		80ns	-	140		
		100ns	-	125		
I_{CC2}	Standby Current (TTL) Power Supply Standby Current (\overline{RAS} , \overline{LCAS} , $\overline{UCAS} = V_{IH}$, $DOUT = High-Z$)	-	2	mA		
I_{CC3}	\overline{RAS} -Only Refresh Current Average Power Supply Current ($t_{RC} = t_{RC\ min}$)	70ns	-	140	mA	2
		80ns	-	130		
		100ns	-	110		
I_{CC4}	Fast Page Mode Current Average Power Supply Current ($t_{RC} = t_{RC\ min}$)	70ns	-	130	mA	1, 3
		80ns	-	120		
		100ns	-	110		
I_{CC5}	Standby Current (CMOS) Power Supply Standby Current (\overline{RAS} , \overline{LCAS} , \overline{UCAS} , \overline{WE} , $\overline{OE} \geq V_{CC} - 0.2V$, $DOUT = High-Z$)	-	1	mA	4	
		-	200	μA	4,5	
I_{CC6}	\overline{CAS} -before- \overline{RAS} Refresh Current ($t_{RC} = t_{RC\ min}$)	70ns	-	140	mA	
		80ns	-	130		
		100ns	-	110		
I_{CC7}	Battery Back Up Current (Standby with CBR Refresh) ($t_{RC} = 125\mu s$, $t_{RAS} \leq 1\mu s$, \overline{WE} , $\overline{OE} = V_{IH}$, \overline{LCAS} , $\overline{UCAS} = V_{IL}$, $DOUT = High-Z$)	-	300	μA	4, 5	
I_{CC8}	Standby Current $\overline{RAS} = V_{IH}$ $\overline{CAS} = V_{IL}$ $DOUT = Enable$	-	5	mA	1	
I_{CC9}	Self-Refresh Mode Current (\overline{RAS} , $\overline{CAS} \leq 0.2V$, $DOUT = High-Z$)	GM71CS4260A	-	1	mA	6
		GM71CS4260AL	-	200	μA	
I_{IQ}	Input Leakage Current Any Input ($0V \leq V_{IN} \leq 7V$)	-10	10	μA		
I_{OQ}	Output Leakage Current ($DOUT$ is Disabled, $0V \leq V_{OUT} \leq 7V$)	-10	10	μA		

Note: 1. I_{CC} depends on output load condition when the device is selected. $I_{CC(max)}$ 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{LCAS} and $\overline{UCAS} = V_{IH}$.

4. $V_{IH} \geq V_{CC} - 0.2V$, $0 \leq V_{IL} \leq 0.2V$, Address can be changed once or less while $\overline{RAS} = V_{IL}$.

5. L-Series.

6. Self-refresh series, (GM71CS4260A/AL)

Capacitance ($V_{CC} = 5V \pm 10\%$, $T_A = 25^\circ C$)

Symbol	Parameter	Min	Max	Unit	Note
C_{in}	Input Capacitance (Address)	-	5	pF	1
C_{in}	Input Capacitance (Clocks)	-	7	pF	1
C_{IO}	Output Capacitance (Data-In/Out)	-	10	pF	1, 2

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

AC Characteristics ($V_{CC} = 5V \pm 10\%$, $T_A = 0 \sim 70^\circ C$, Notes 1, 14, 15, 17, 18)

Test Conditions

Input rise and fall times : 5ns

Output load : 2TTL gate + C_L (100pF)

Input, output timing reference level : 0.8V, 2.4V

(Including scope and jig)

Read, Write, Read-Modify-Write and Refresh Cycles (Common Parameters)

Symbol	Parameter	GM71C(S)4260 A/AAL-70		GM71C(S)4260 A/AAL-90		GM71C(S)4260 A/AAL-10		Unit	Note
		Min	Max	Min	Max	Min	Max		
t_{RC}	Random Read or Write Cycle Time	130	-	150	-	180	-	ns	
t_{RP}	\overline{RAS} Precharge Time	50	-	60	-	70	-	ns	
t_{RAS}	\overline{RAS} Pulse Width	70	10,000	80	10,000	100	10,000	ns	
t_{CAS}	\overline{CAS} Pulse Width	20	10,000	20	10,000	25	10,000	ns	23
t_{ASR}	Row Address Set-up Time	0	-	0	-	0	-	ns	
t_{RAH}	Row Address Hold Time	10	-	10	-	15	-	ns	
t_{ASC}	Column Address Set-up Time	0	-	0	-	0	-	ns	19
t_{CAH}	Column Address Hold Time	15	-	15	-	20	-	ns	19
t_{RCD}	\overline{RAS} to \overline{CAS} Delay Time	20	50	20	60	25	75	ns	8
t_{RAD}	\overline{RAS} to Column Address Delay Time	15	35	15	40	20	55	ns	9
t_{RSH}	\overline{RAS} Hold Time	20	-	20	-	25	-	ns	
t_{CSH}	\overline{CAS} Hold Time	70	-	80	-	100	-	ns	
t_{CRP}	\overline{CAS} to \overline{RAS} Precharge Time	15	-	15	-	15	-	ns	20, 24
t_{ODD}	\overline{OE} to D_{IN} Delay Time	20	-	20	-	25	-	ns	
t_{DZO}	\overline{OE} Delay Time from D_{IN}	0	-	0	-	0	-	ns	
t_{DZC}	\overline{CAS} Setup Time from D_{IN}	0	-	0	-	0	-	ns	
t_r	Transition Time (Rise and Fall)	3	50	3	50	3	50	ns	7
t_{REF}	Refresh Period	-	8	-	8	-	8	ms	
	Refresh Period (L-Series)	-	128	-	128	-	128	ms	

Read Cycle

Symbol	Parameter	GM71C(S)4260 A/JAL-70		GM71C(S)4260 A/JAL-80		GM71C(S)4260 A/JAL-10		Unit	Note
		Min	Max	Min	Max	Min	Max		
t _{RAC}	Access Time from $\overline{\text{RAS}}$	-	70	-	80	-	100	ns	2, 3
t _{CAC}	Access Time from $\overline{\text{CAS}}$	-	20	-	20	-	25	ns	3, 4, 13
t _{AA}	Access Time from Address	-	35	-	40	-	45	ns	3, 5, 13
t _{OAC}	Access Time from $\overline{\text{OE}}$	-	20	-	20	-	25	ns	3, 23
t _{RCS}	Read Command Setup Time	0	-	0	-	0	-	ns	19
t _{RCH}	Read Command Hold Time to $\overline{\text{CAS}}$	0	-	0	-	0	-	ns	16, 19
t _{RRH}	Read Command Hold Time to $\overline{\text{RAS}}$	0	-	0	-	0	-	ns	16
t _{RAL}	Column Address to $\overline{\text{RAS}}$ Lead Time	35	-	40	-	45	-	ns	
t _{OFF1}	Output Buffer Turn-off Time	0	15	0	15	0	20	ns	6
t _{OFF2}	Output Buffer Turn-off Time from $\overline{\text{OE}}$	0	15	0	15	0	20	ns	6
t _{CDD}	$\overline{\text{CAS}}$ to $\overline{\text{DN}}$ Delay Time	15	-	15	-	20	-	ns	

Write Cycle

Symbol	Parameter	GM71C(S)4260 A/JAL-70		GM71C(S)4260 A/JAL-80		GM71C(S)4260 A/JAL-10		Unit	Note
		Min	Max	Min	Max	Min	Max		
t _{WCS}	Write Command Setup Time	0	-	0	-	0	-	ns	10, 19
t _{WCH}	Write Command Hold Time	15	-	15	-	20	-	ns	19
t _{WP}	Write Command Pulse Width	10	-	10	-	20	-	ns	
t _{RWL}	Write Command to $\overline{\text{RAS}}$ Lead Time	20	-	20	-	25	-	ns	
t _{CWL}	Write Command to $\overline{\text{CAS}}$ Lead Time	20	-	20	-	25	-	ns	21
t _{DS}	Data-in Setup Time	0	-	0	-	0	-	ns	11, 21
t _{DH}	Data-in Hold Time	15	-	15	-	20	-	ns	11, 21
t _{COD}	$\overline{\text{CAS}}$ to $\overline{\text{OE}}$ Delay Time	-	0	-	0	-	0	ns	23

Read-Modify-Write Cycle

Symbol	Parameter	GM71C(S)4260 A/AL-70		GM71C(S)4260 A/AL-80		GM71C(S)4260 A/AL-10		Unit	Note
		Min	Max	Min	Max	Min	Max		
t _{RWC}	Read-Modify-Write Cycle Time	180	-	200	-	245	-	ns	
t _{RWD}	$\overline{\text{RAS}}$ to $\overline{\text{WE}}$ Delay Time	95	-	105	-	135	-	ns	10
t _{CWD}	$\overline{\text{CAS}}$ to $\overline{\text{WE}}$ Delay Time	45	-	45	-	60	-	ns	10
t _{AWD}	Column Address to $\overline{\text{WE}}$ Delay Time	60	-	65	-	80	-	ns	10
t _{OEH}	$\overline{\text{OE}}$ Hold Time from $\overline{\text{WE}}$	20	-	20	-	25	-	ns	

Refresh Cycle

Symbol	Parameter	GM71C(S)4260 A/AL-70		GM71C(S)4260 A/AL-80		GM71C(S)4260 A/AL-10		Unit	Note
		Min	Max	Min	Max	Min	Max		
t _{CSR}	$\overline{\text{CAS}}$ Setup Time ($\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ Refresh Cycle)	10	-	10	-	10	-	ns	19
t _{CHR}	$\overline{\text{CAS}}$ Hold Time ($\overline{\text{CAS}}$ -before- $\overline{\text{RAS}}$ Refresh Cycle)	10	-	10	-	10	-	ns	20
t _{RPC}	$\overline{\text{RAS}}$ Precharge to $\overline{\text{CAS}}$ Hold Time	10	-	10	-	10	-	ns	19
t _{CPN}	$\overline{\text{CAS}}$ Precharge Time in Normal Mode	10	-	10	-	10	-	ns	22

Fast Page Mode Cycle

Symbol	Parameter	GM71C(S)4260 A/AL-70		GM71C(S)4260 A/AL-80		GM71C(S)4260 A/AL-10		Unit	Note
		Min	Max	Min	Max	Min	Max		
t _{PC}	Fast Page Mode Cycle Time	45	-	50	-	55	-	ns	
t _{CP}	Fast Page Mode $\overline{\text{CAS}}$ Precharge Time	10	-	10	-	10	-	ns	22
t _{RASC}	Fast Page Mode $\overline{\text{RAS}}$ Pulse Width	-	100,000	-	100,000	-	100,000	ns	12
t _{ACP}	Access Time from $\overline{\text{CAS}}$ Precharge	-	40	-	45	-	50	ns	3, 13, 20
t _{RHCP}	$\overline{\text{RAS}}$ Hold Time from $\overline{\text{CAS}}$ Precharge	40	-	45	-	50	-	ns	
t _{CPW}	Fast Page Mode Read-Modify-Write Cycle $\overline{\text{CAS}}$ Precharge to $\overline{\text{WE}}$ Delay Time	65	-	70	-	85	-	ns	
t _{PCM}	Fast Page Mode Read-Modify-Write Cycle Time	95	-	100	-	110	-	ns	

Self-Refresh Mode

Symbol	Parameter	GM71CS4260 A/AL-70		GM71CS4260 A/AL-80		GM71CS4260 A/AL-10		Unit	Note
		Min	Max	Min	Max	Min	Max		
t _{RASS}	$\overline{\text{RAS}}$ Pulse Width (Self-Refresh)	100	-	100	-	100	-	ns	
t _{RPS}	$\overline{\text{RAS}}$ Precharge Time (Self-Refresh)	130	-	150	-	180	-	ns	
t _{CHS}	$\overline{\text{CAS}}$ Hold Time (Self-Refresh)	-50	-	-50	-	-50	-	ns	21

Notes:

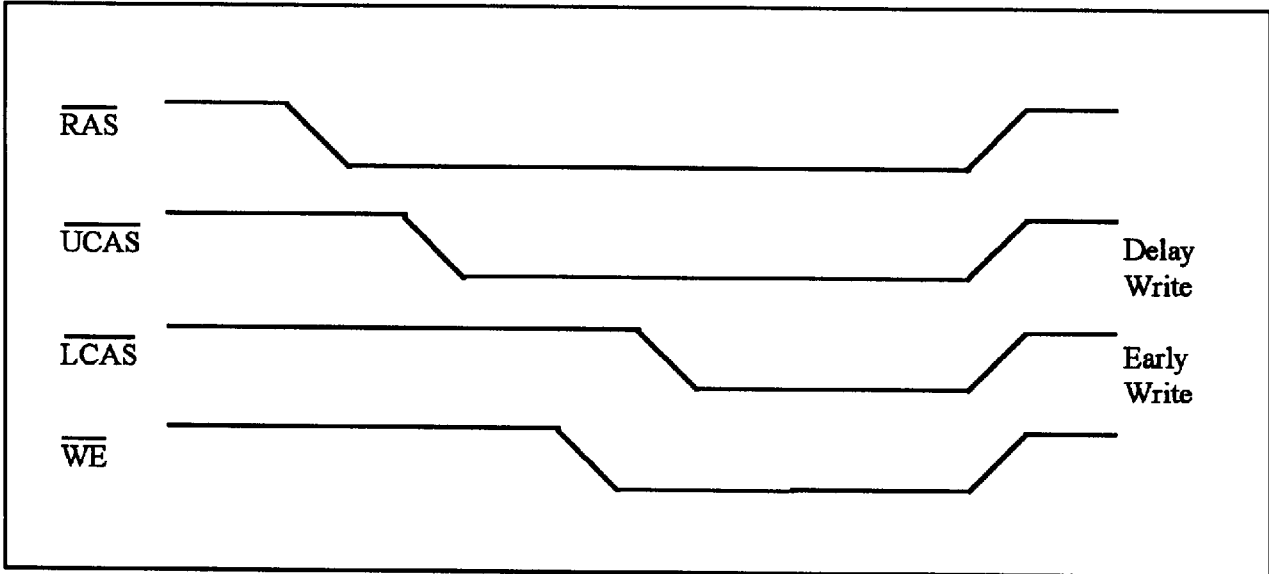
1. AC Measurements assume $t_r = 5 \text{ ns}$.
2. Assumes that $t_{\text{RCD}} \leq t_{\text{RCD}}(\text{max})$ and $t_{\text{RAD}} \leq t_{\text{RAD}}(\text{max})$. If t_{RCD} or t_{RAD} is greater than the maximum recommended value shown in this table, t_{RAC} exceeds the value shown.
3. Measured with a load circuit equivalent to 2TTL loads and 100pF.
4. Assumes that $t_{\text{RCD}} \geq t_{\text{RCD}}(\text{max})$ and $t_{\text{RAD}} \leq t_{\text{RAD}}(\text{max})$.
5. Assumes that $t_{\text{RCD}} \leq t_{\text{RCD}}(\text{max})$ and $t_{\text{RAD}} \geq t_{\text{RAD}}(\text{max})$.
6. $t_{\text{off}}(\text{max})$ defines the time at which the output achieves the open circuit condition and is not referenced to output voltage levels.
7. $V_{\text{IH}}(\text{min})$ and $V_{\text{IL}}(\text{max})$ are reference levels for measuring timing of input signals. Also, transition times are measured between V_{IH} and V_{IL} .
8. Operation with the $t_{\text{RCD}}(\text{max})$ limit insures that $t_{\text{RAC}}(\text{max})$ can be met, $t_{\text{RCD}}(\text{max})$ is specified as a reference point only; if t_{RCD} is greater than the specified $t_{\text{RCD}}(\text{max})$ limit, then access time is controlled exclusively by t_{CAC} .
9. Operation with the $t_{\text{RAD}}(\text{max})$ limit insures that $t_{\text{RAC}}(\text{max})$ can be met, $t_{\text{RAD}}(\text{max})$ is specified as a reference point only; if t_{RAD} is greater than the specified $t_{\text{RAD}}(\text{max})$ limit, then access time is controlled exclusively by t_{AA} .
10. t_{WCS} , t_{RWd} , t_{CWD} , t_{AWd} and t_{CPW} are not restrictive operating parameters. They are included in the data sheet as electrical characteristics only; if $t_{\text{WCS}} \geq t_{\text{WCS}}(\text{min})$, the cycle is an early write cycle and the data out pin will remain open circuit (high impedance) throughout the entire cycle; if $t_{\text{RWd}} \geq t_{\text{RWd}}(\text{min})$, $t_{\text{CWD}} \geq t_{\text{CWD}}(\text{min})$, $t_{\text{AWd}} \geq t_{\text{AWd}}(\text{min})$ and $t_{\text{CPW}} \geq t_{\text{CPW}}(\text{min})$, the cycle is a read modify 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 referred to $\overline{\text{CAS}}$ leading edge in early write cycle and to $\overline{\text{WE}}$ leading edge in a delayed write or a read modify write cycle.
12. t_{RASC} defines $\overline{\text{RAS}}$ pulse width in fast page mode cycles.
13. Access time is determined by the longer of t_{AA} or t_{CAC} or t_{ACP} .
14. An initial pause of 100 μs is required after power up followed by a minimum of eight initialization cycles ($\overline{\text{RAS}}$ only refresh cycle or $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh cycle). If the internal refresh counter is used, a minimum of eight $\overline{\text{CAS}}$ before $\overline{\text{RAS}}$ refresh cycles is required.

15. In delayed write or read-modify-write cycles, \overline{OE} must disable output buffer prior to applying data to the device.
16. Either t_{RCH} or t_{RRH} must be satisfied for a read cycle.
17. When both \overline{LCAS} and \overline{UCAS} go low at the same time, all 16-bits data are written into the device. \overline{LCAS} and \overline{UCAS} cannot be straggled within the same write/read cycles.
18. All the V_{CC} and V_{SS} pins shall be supplied with the same voltages.
19. t_{ASC} , t_{CAH} , t_{RCS} , t_{RCH} , t_{WCS} , t_{WCH} , t_{CSR} and t_{RPC} are determined by the earlier falling edge of \overline{UCAS} or \overline{LCAS} .
20. t_{CRP} , t_{CHR} , t_{ACP} and t_{CPW} are determined by the later rising edge of \overline{UCAS} or \overline{LCAS} .
21. t_{CWL} , t_{DH} , t_{DS} and t_{CHS} should be satisfied by both \overline{UCAS} and \overline{LCAS} .
22. t_{CPN} and t_{CP} are determined by the time that both \overline{UCAS} and \overline{LCAS} are high.
23. When output buffers are enabled once, sustain the low impedance state until valid data is obtained. When output buffer is turned on and off within a very short time, generally it causes large V_{CC}/V_{SS} line noise, which causes to degrade $V_{IH\ min}/V_{IL\ max}$ level.
24. t_{CRP} is planned to be improved to match the standard DRAM specifications.
25. If you use distributed CBR refresh mode with $15.6\ \mu s$ interval in normal read/write cycle, CBR refresh should be executed within $15.6\ \mu s$ immediately after exiting from and before entering into self refresh mode.
26. If you use \overline{RAS} only refresh or CBR burst refresh mode in normal read/write cycle, 512 cycles of distributed CBR refresh with $15.6\ \mu s$ interval should be executed within $8ms$ immediately after exiting from and before entering into self refresh mode.
27. Repetitive self refresh mode without refreshing all memory is not allowed. Once you exit from self refresh mode, all memory cells need to be refreshed before re-entering the self refresh mode again.

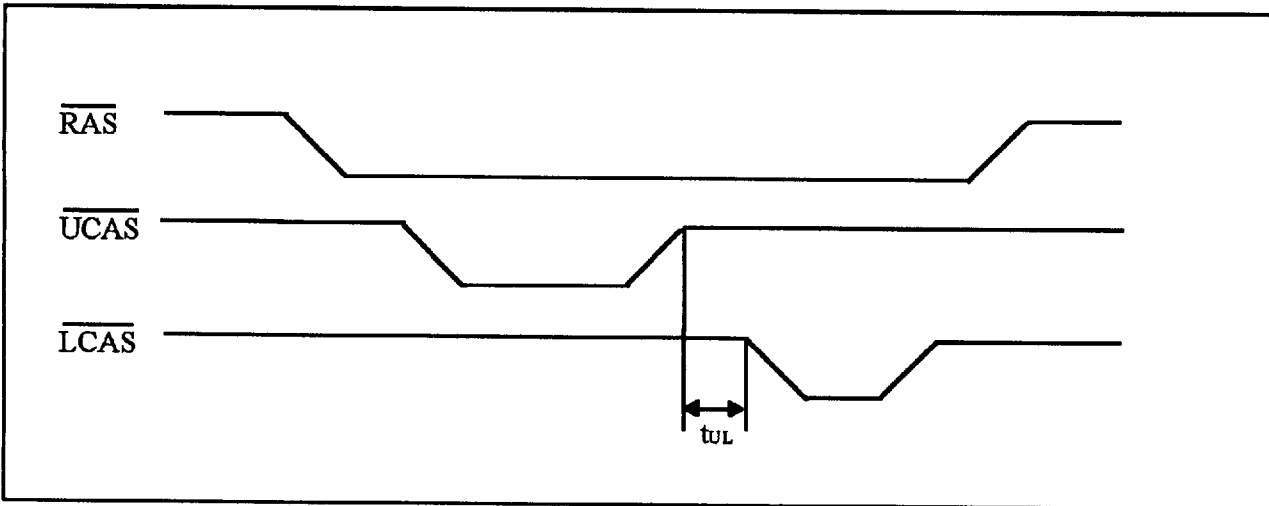
Notes concerning $\overline{2CAS}$ control

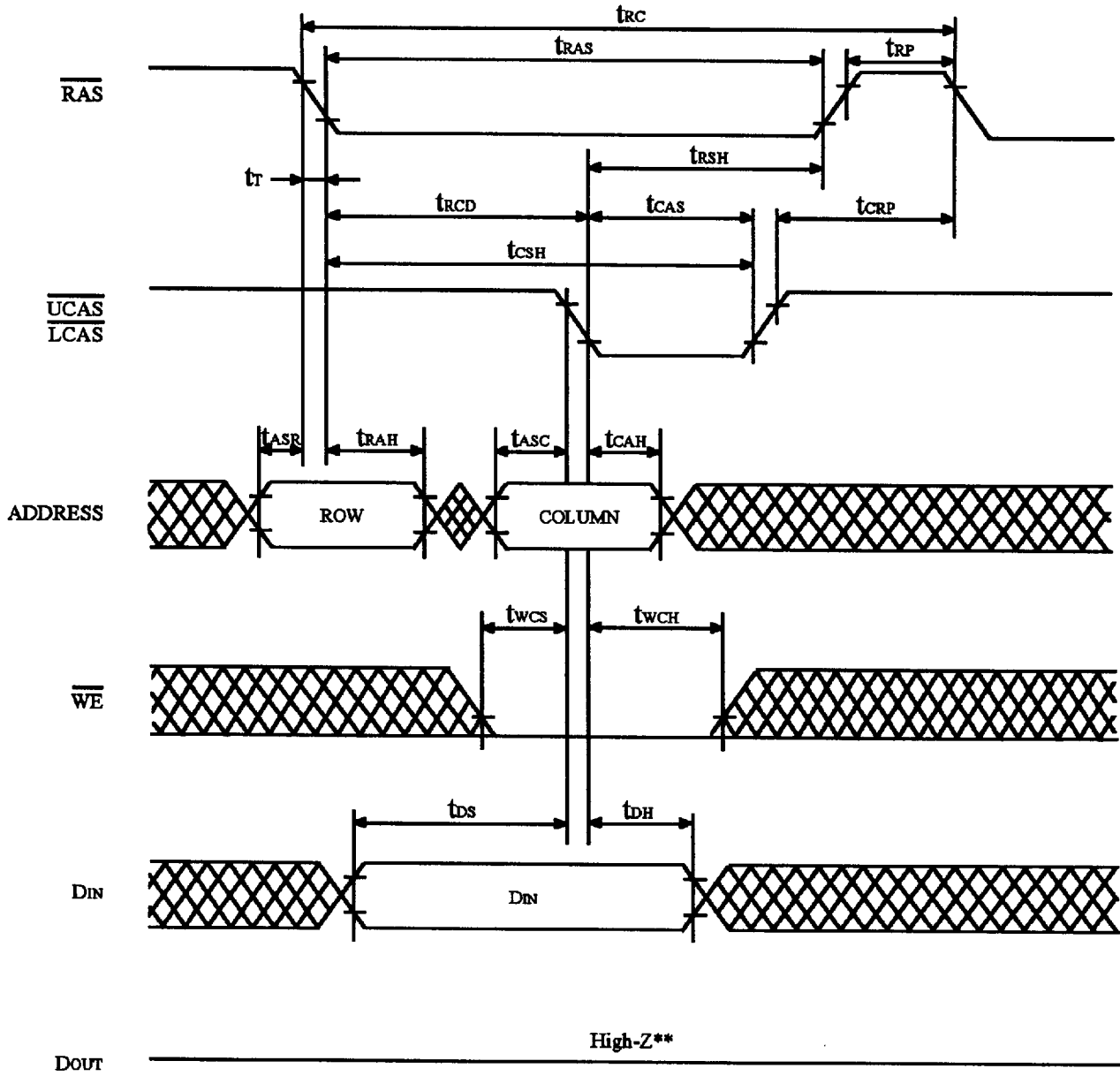
Please do not separate the $\overline{UCAS/LCAS}$ operation timing intentionally. However skew between $\overline{UCAS/LCAS}$ are allowed under the following conditions.

- 1) Each of the $\overline{UCAS/LCAS}$ should satisfy the timing specifications individually.
- 2) Different operation mode for upper/lower byte is not allowed; such as following.



- 3) Closely separated upper/lower byte control is not allowed. However when the condition ($t_{CP} \leq t_{UL}$) is satisfied, fast page mode can be performed.

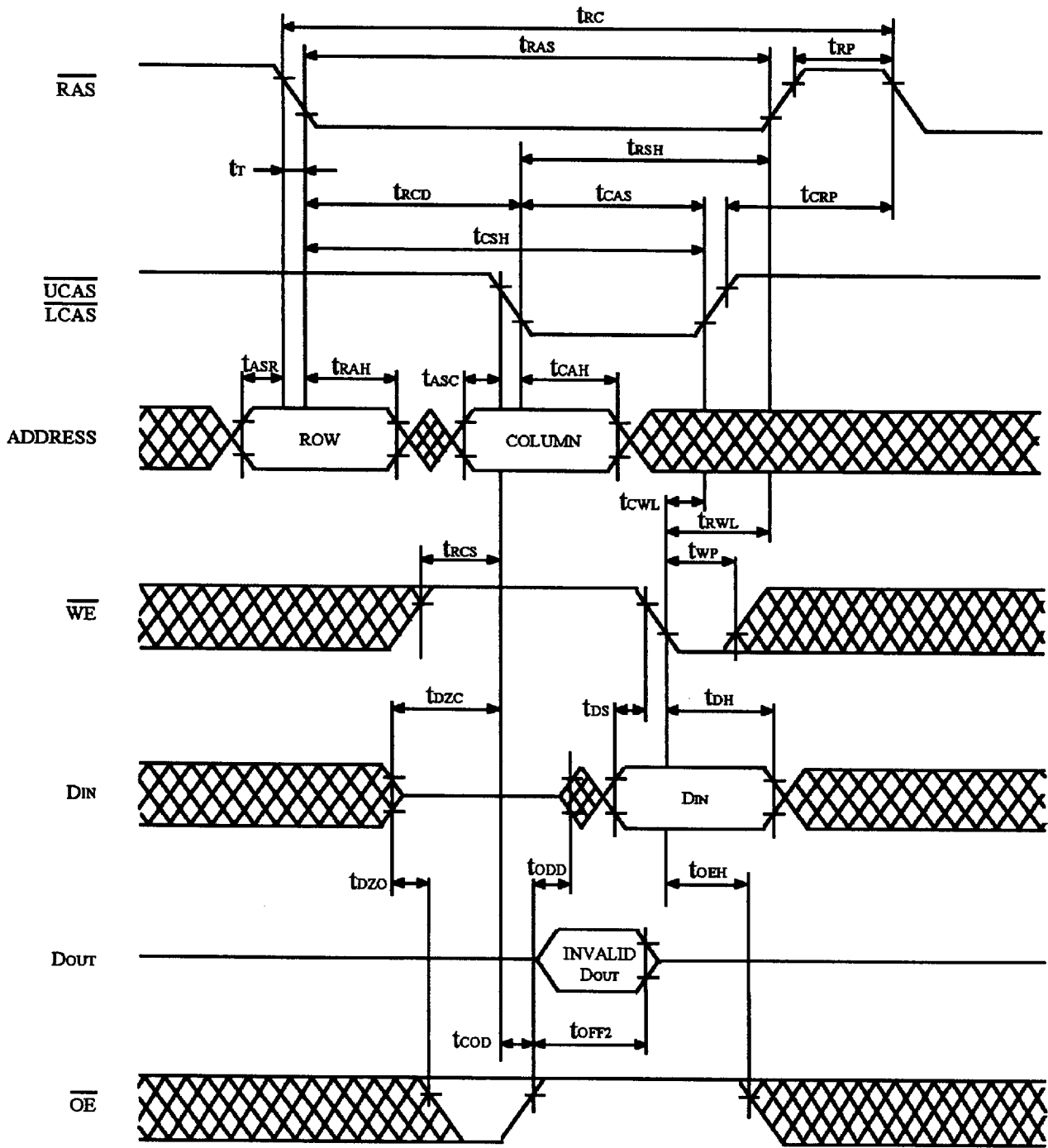





*  : Don't care

** \overline{OE} : Don't care

FIGURE 2. EARLY WRITE CYCLE



*  : Don't care

** Do not enable D_{out} during delayed write cycle

FIGURE 3. DELAYED WRITE CYCLE

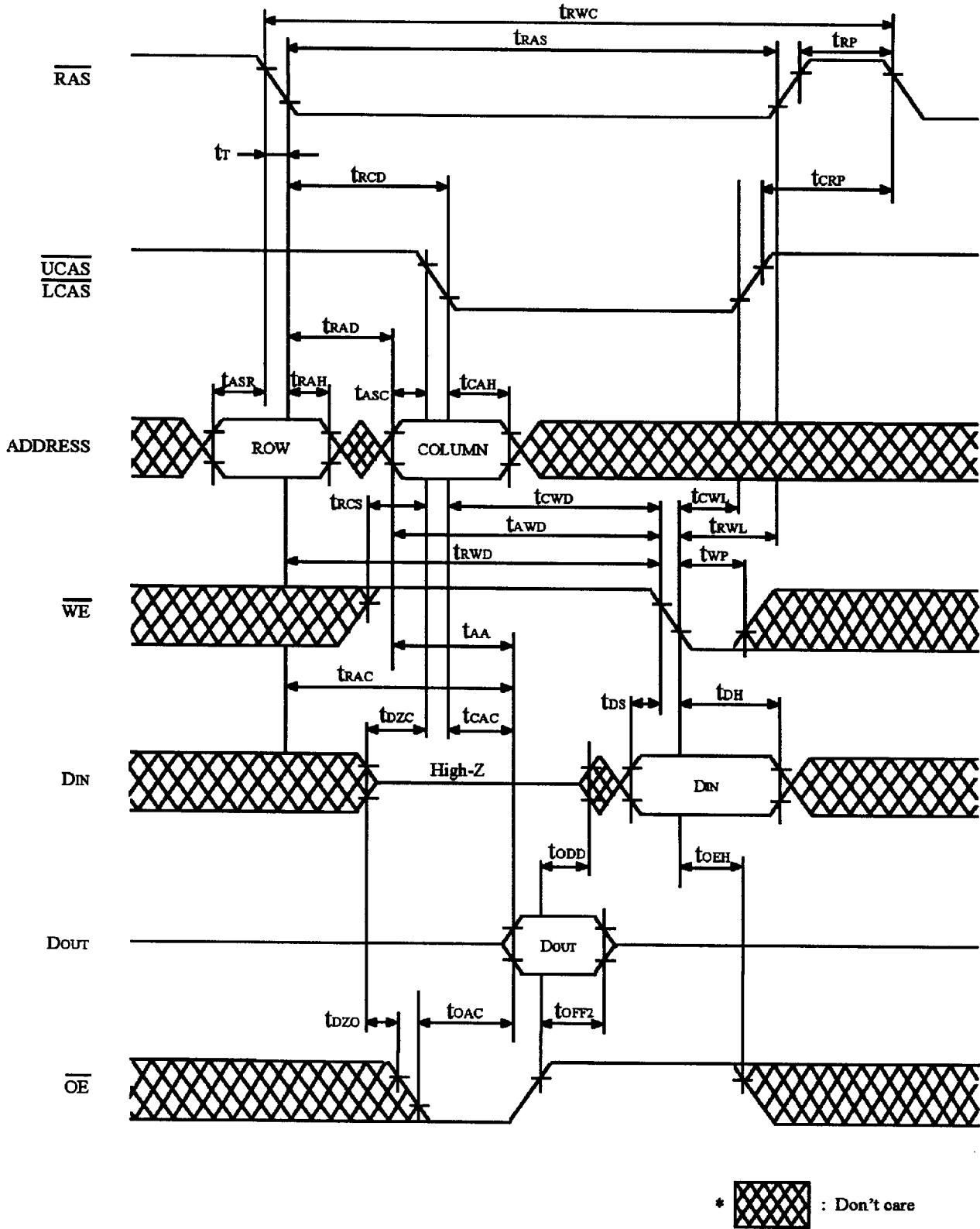
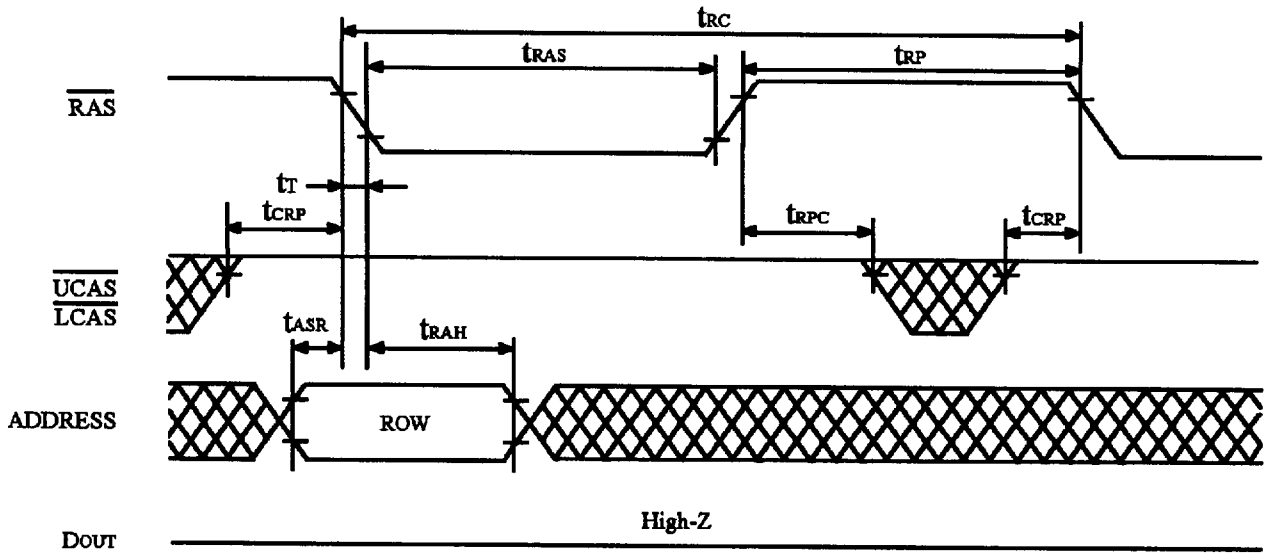
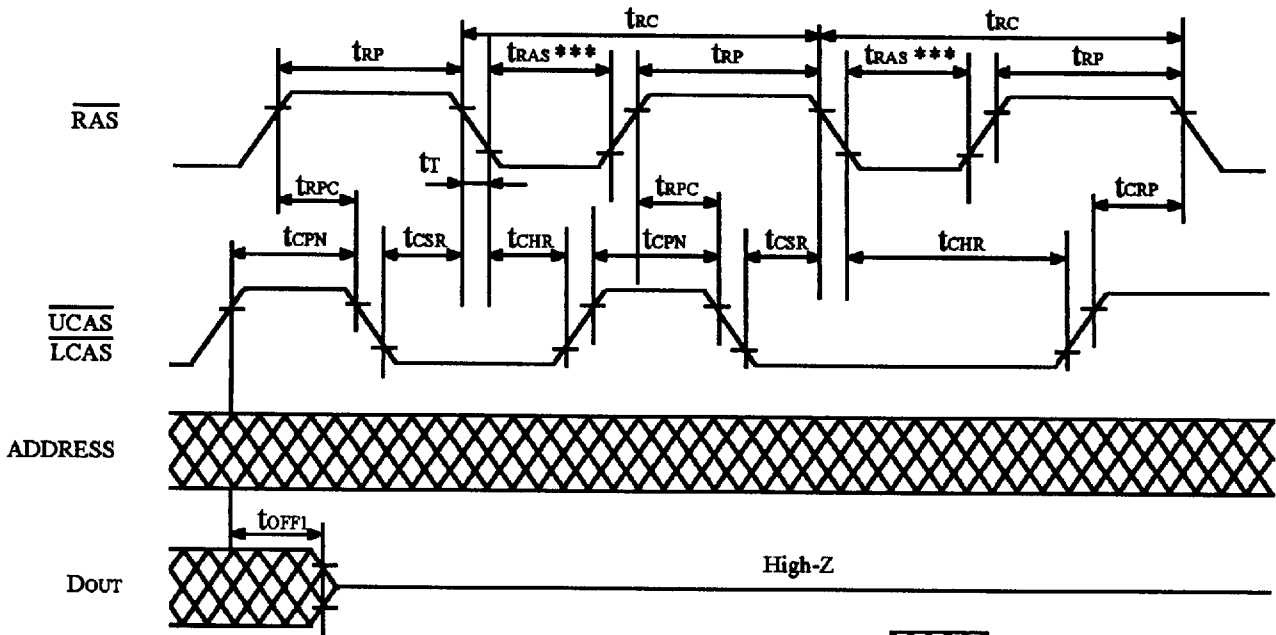


FIGURE 4. READ MODIFY WRITE CYCLE



* $\overline{\text{OE}}, \overline{\text{WE}}$: Don't care
 ** Refresh Address: A0-A8 (AX0-AX8)

FIGURE 5. $\overline{\text{RAS}}$ ONLY REFRESH CYCLE




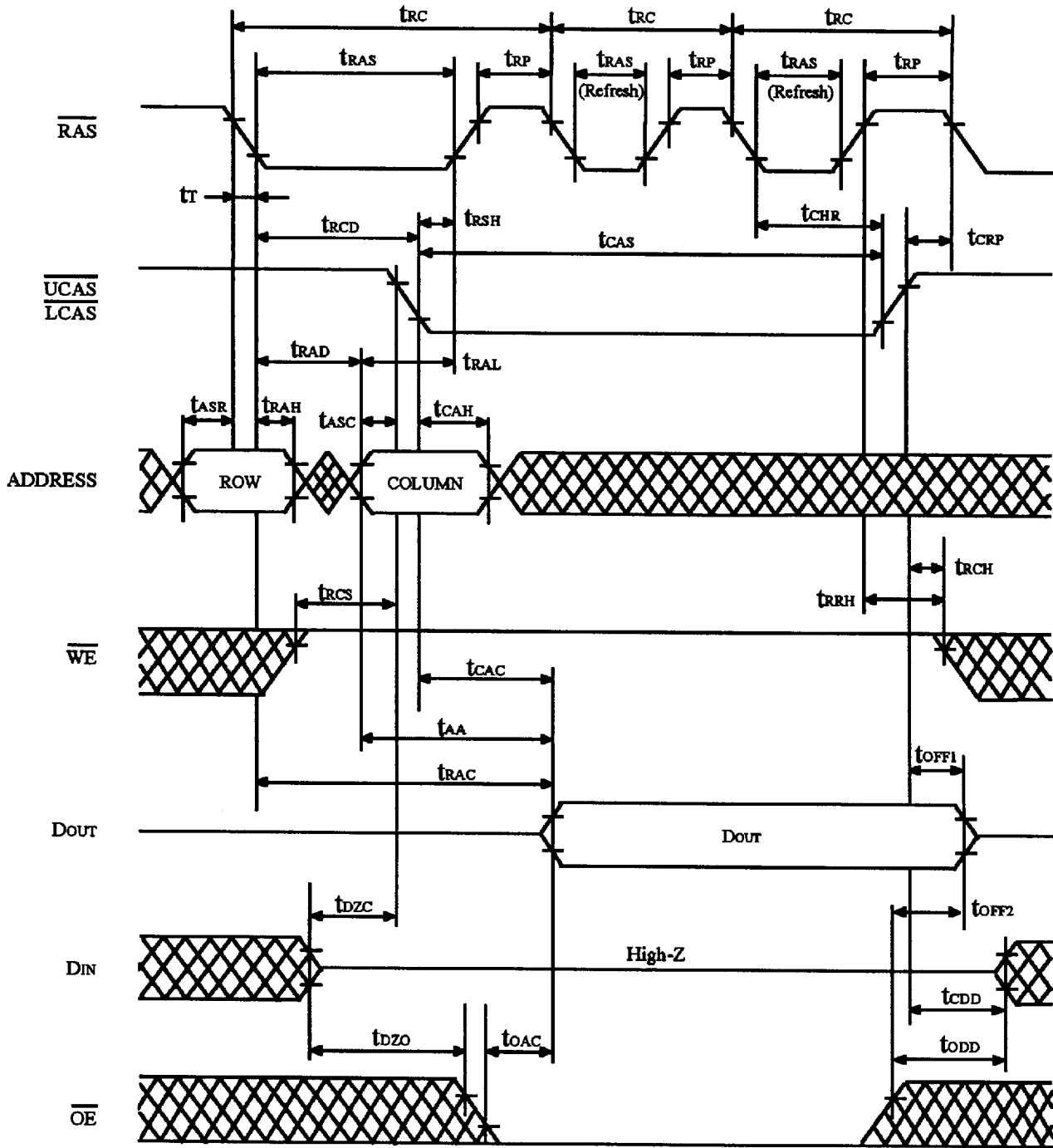
*  : Don't care
 ** $\overline{\text{OE}}, \overline{\text{WE}}$: Don't care
 *** Don't extend $t_{\text{RAS}} \geq t_{\text{RAS}}(\text{Max})$.
 Untested self refresh mode may be activated and loss of data may be resulted

FIGURE 6. $\overline{\text{CAS}}$ BEFORE $\overline{\text{RAS}}$ REFRESH CYCLE



*  : Don't care

FIGURE 7. HIDDEN REFRESH CYCLE

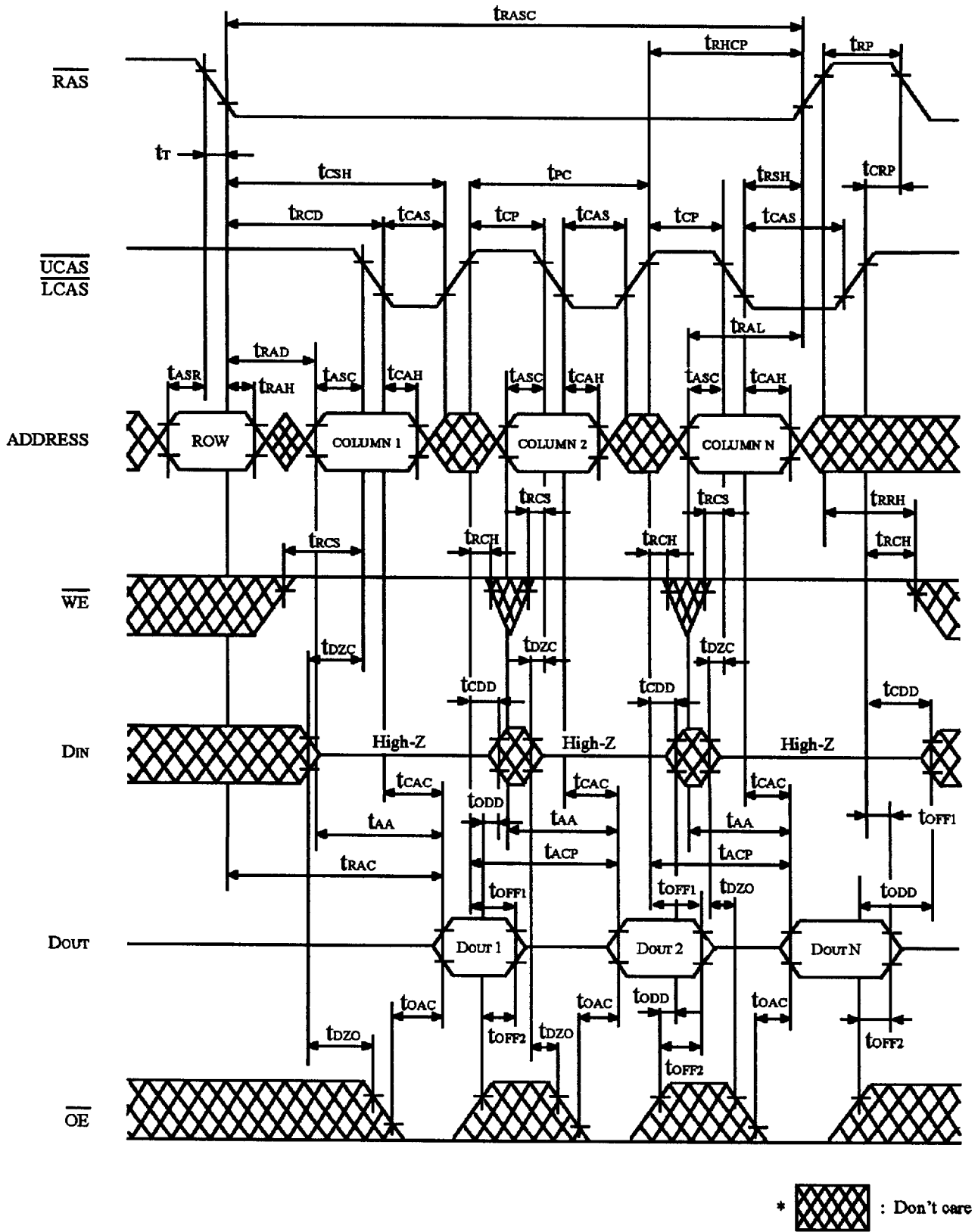
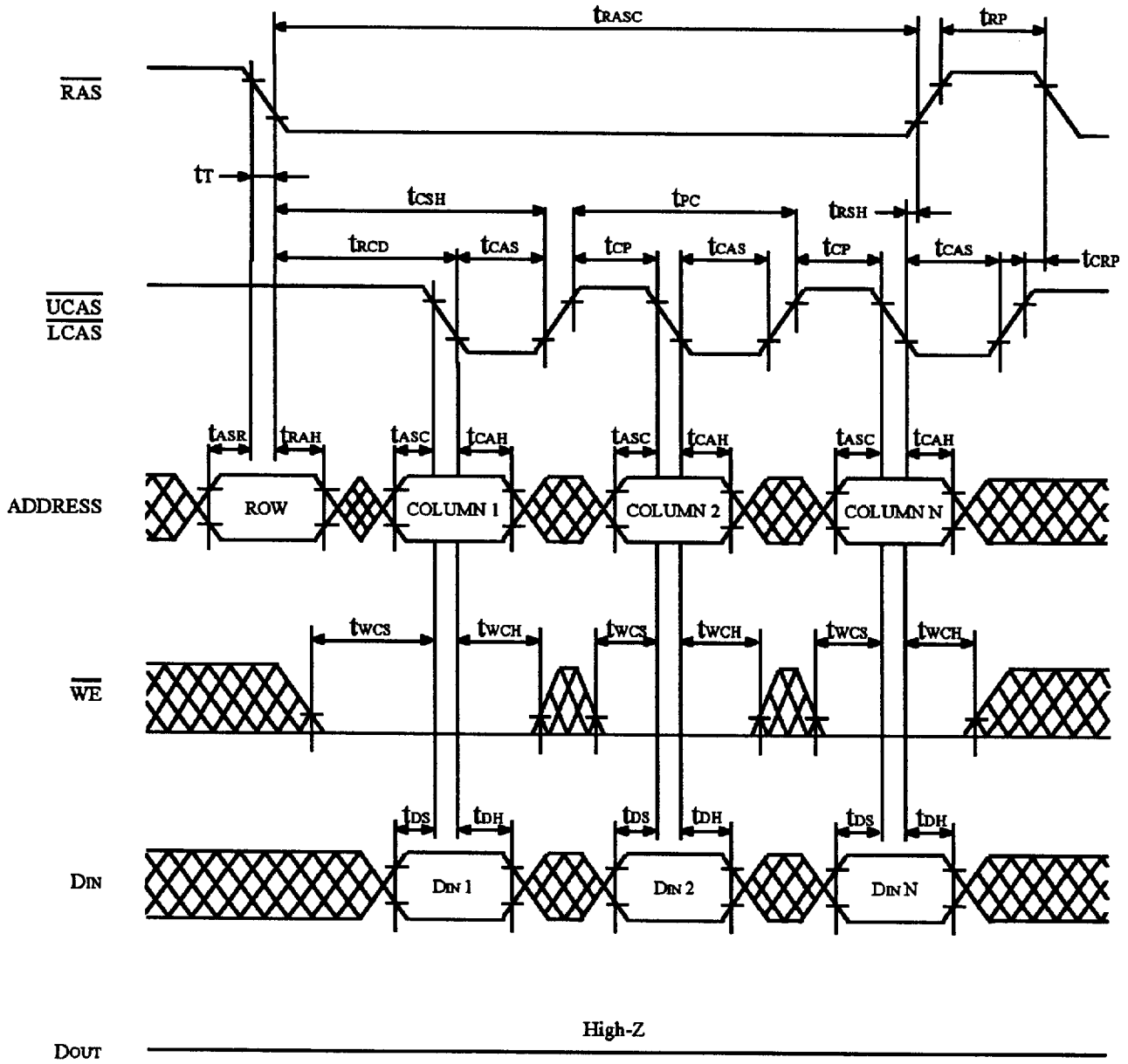


FIGURE 8. FAST PAGE MODE READ CYCLE




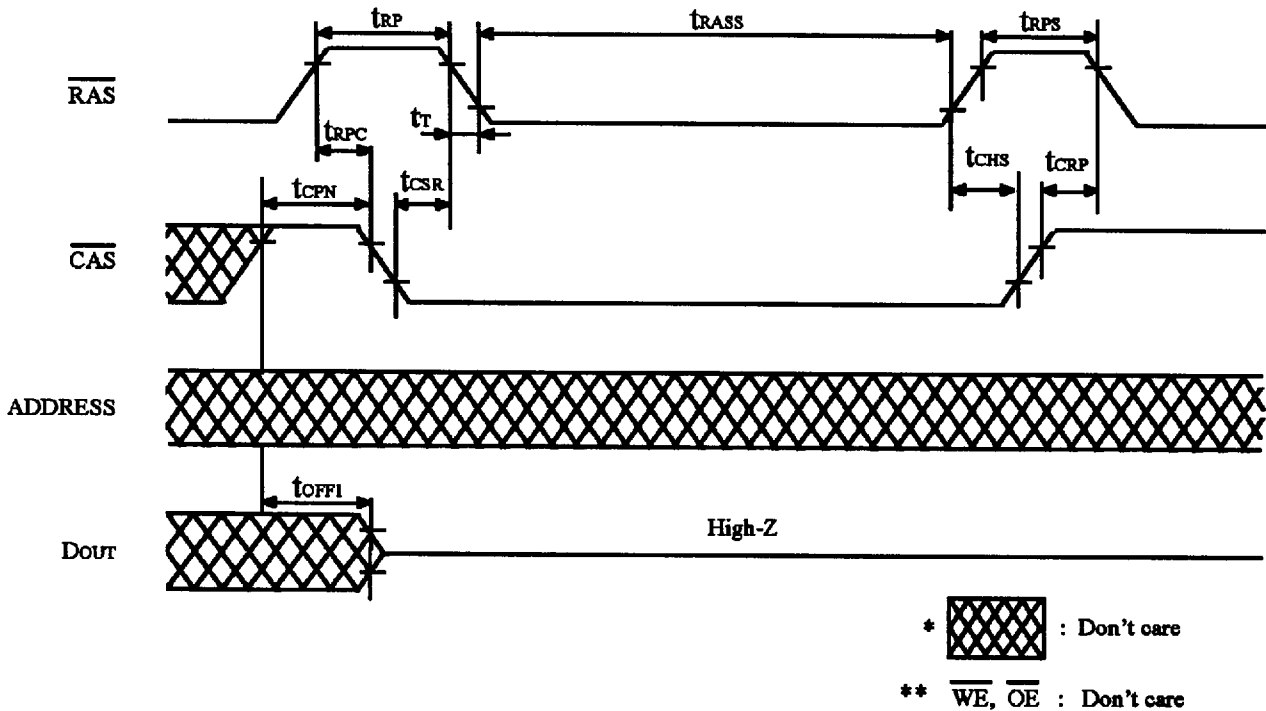
* \overline{OE} : Don't care
 **  : Don't care

FIGURE 9. FAST PAGE MODE EARLY WRITE CYCLE



The low self refresh current is achieved by introducing extremely long internal refresh cycle. Therefore some care needs to be taken on the refresh.

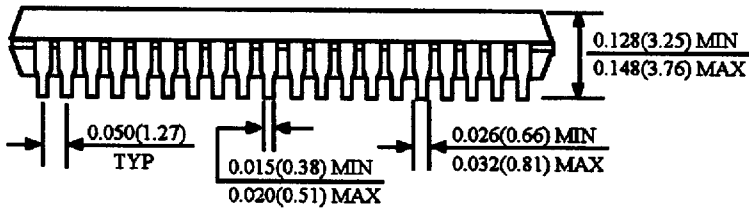
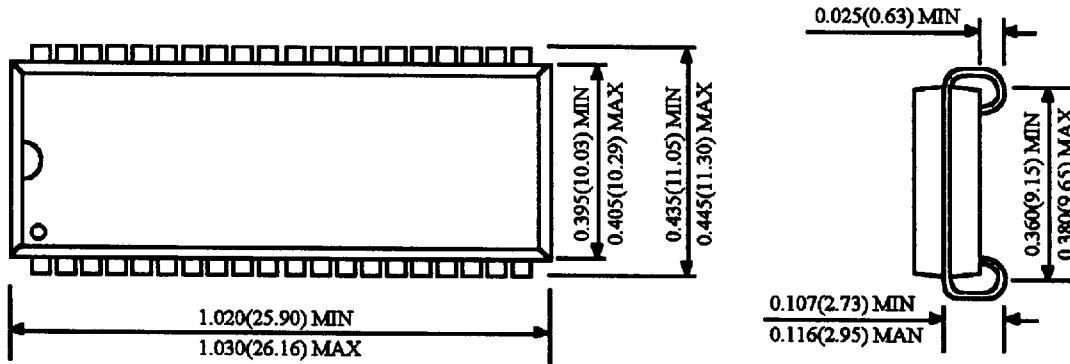
1. Please do not t_{RASS} timing, $10\mu\text{s} \leq t_{\text{RASS}} \leq 100\mu\text{s}$. During this period, the device is in transition state from normal operation mode to self refresh mode. If $t_{\text{RASS}} \geq 100\mu\text{s}$, the $\overline{\text{RAS}}$ precharge time should use t_{RPS} instead of t_{RP} .
2. If you use $\overline{\text{RAS}}$ only refresh or CBR burst refresh mode in normal read/write cycle, 512 cycle of distributed CBR refresh with $15.6\mu\text{s}$ interval should be executed within 8ms immediately after exiting from and before entering into the self refresh mode.
3. If you use distributed CBR refresh mode with $15.6\mu\text{s}$ interval in normal read/write, CBR refresh should be executed within $15.6\mu\text{s}$ immediately after exiting from and before entering into the self refresh mode.
4. Repetitive self refresh mode without refreshing all memory is not allowed. Once you exit from self refresh mode, all memory cells need to be refreshed before re-entering the self refresh mode again.

FIGURE 12. SELF-REFRESH CYCLE

Package Dimensions

Unit: Inches (mm)

SOJ



TSOP

